THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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TRADE AND GOVERNMENT.

THE General Election being now practically over, the time has arrived when one may examine the situation from the point of view of those who are interested in trade and commerce. With the purely political aspect of the matter we have no concern. Free Trade and Tariff Reform have their votaries in all parts of the country just as they had their advocates on every platform. Strange views and theories have been put forward by these enthusiastic orators. If you went to one meeting you would hear a man on the platform say that the period of depression through which the country has been passing was due to Free Trade. If you went to the next street corner, you would hear it declaimed, in no uncertain tones, that the revival which is becoming manifest is due to the maintenance of our present fiscal system. In the result, however, we have a drawn battle—the draw being in favour of Free Trade. Interesting deductions are being made from the result. Many of them are as far asunder as the poles; but we fancy that the desire of most people who are concerned with arts and manufactures is to be let alone. If the result of the election is to stop the legislative clock for a time, we can almost hear the manufacturers give a sigh of relief.

In recent years, the one desire of the Government of the day appears to have been to produce as many statutes as possible. Each statute is generally attended—like a comet—with a long tail of statutory rules and orders, which are the more annoying because their drafting and interpretation are left to the paid officials of the Government. But there is something else. The immediate consequences of legislation may have been foreseen. The skilful debaters who oppose a Bill when it is passing through the House may draw attention to, and secure amendments to provide against, minor defects; but it is not until the test of experience is applied that the unlooked-for consequences are fully appreciated.

And even where responsible statesmen are made fully aware of these remoter consequences, it often happens that the warning voice is unheard by the public, who are clamouring for legislation. A single illustration will suffice. Only the other day it was announced that the Australian Legislature had taken a leaf out of our statute book, and had passed a new Patent Act which involved the compulsory working of Australian patents in Australia. This is one of the unlooked-for consequences of our Act of 1907; yet it cannot be said to have been unexpected by the Minister who was responsible for our Act. In the course of an address at the Chartered Institute of Patent Agents on November 24th, 1909, Mr. Imray, the President of the Institute, said: "It was pointed out to Mr. Lloyd George during the passage of the Bill that, if the proposed Act became law, the majority of the British Colonies would, in due course, probably assimilate their laws to that of the home country as

had hitherto been the practice, and that while it might suit our colonies to compel British as well as foreign patentees to establish factories in each colony or forfeit their rights, still it would entail great hardship on the home patentee. At the time when these words were uttered, the Australian Parliament had the Bill above referred to under consideration. It has now become law in the colony. The more highly specialised does legislation become, the more difficult it is to see where it is going to lead.

The truth is, of course, that in recent years the British Government has been gradually showing a tendency to interfere too much in matters which concern it not. State intervention may extend to controlling the free agency of individuals—in which case its every action has to be scrutinised with the utmost care. As Mill has pointed out in his famous "Political Economy," "whatever theory we adopt respecting the foundation of the social union, and under whatever political institutions we live, there is a circle around every human being which no Government, be it that of one, of a few, or of the many, ought to be permitted to overstep; there is a part of the life of every person who has come to years of discretion, within which the individuality of that person ought to reign uncontrolled either by any other individual, or by the public collectively." If these precepts have always been worthy of approval, they are doubly so at the present time, seeing that the tendency of modern civilisation is to make the power of persons acting in masses the only substantial power in society. From such an authority there is no appeal.

Even if the too free exercise of Government intervention were not undesirable for these reasons, there are many others which may be assigned. Every additional function undertaken by the Government is a fresh occupation imposed upon a body already overcharged with duties. Further than this, it is sometimes forgotten by those who legislate, that people understand their own business and their own interests better, and care for them more, than the Government does or can be expected to do. The Government, looking at it for the moment as if embarking upon an enterprise, is less interested in the result than an individual or group of individuals with the eye on the main chance. As Mill has rightly observed: "Letting alone, in short, should be the general practice; every departure from it, *unless required by some great good*, is a certain evil."

The proviso (which we have printed in italics) is the peg upon which the modern legislator would hang many of his schemes of social reform. He would say: "the working classes must be protected," or "the capitalist is too powerful and must be controlled." But it is too often forgotten that the working man nowadays has an uncommonly good notion of looking after himself. He can make a protest and back it up with the power born of combination. It will be said, of course, that these powers of combination are the result of legislation. They may be, in part: but our present purpose is not to decry the legislation of the past. We only desire to record our protest against hasty and ill-considered legislation in the future.

As to attempts to control the employer and the capitalist, these may be successful, for a time. But, like the workman, the capitalist is able to take care of himself, or, what is more important, he can do what he likes with his capital. If he is unduly harassed in one industry he can embark upon another: if the laws are too rigid in this country, he can move abroad. It is for these reasons that we hope that the new Parliament may find itself compelled to call a halt in the matter of legislation.

Copper.

By way of elucidating the situation on the projected combine, the interviewers have been busy with Mr. Daniel Guggenheim, President of the American Smelting and Refining Co., and one of the leading men in the copper producing industry. According to the *Financier*, Mr. Guggenheim takes the view that present prices are exceptionally low, and that they fail to pay the mines in many cases. The Utah and Nevada concerns can, however, produce at a fair profit on these prices. He points out the disadvantage of excessive fluctuations in price, which are sufficiently patent. With regard to the financial side of the affair, Mr. Guggenheim tells us that during the five months ensuing between the time the ore is mined and the copper is paid for by the consumer, the banks and trust companies are accustomed to advance enormous sums against warehouse receipts, covering the copper in its various conditions. Risk of a large shrinkage in value is taken by these tenders, and an apparent weakness of the market tends to heavy covering and consequent panic. In times of high prices mines of little value are floated on these loans, and cannot stand long.

Mr. Guggenheim naturally argues that an arrangement tending to make the price more stable must be advantageous to the industry itself and its derived manufactures.

He refers to the existence of copper in Alaska, properties there being described as very rich, but only to be rendered accessible by very heavy expenditure, such as a large concern alone could undertake, and this, of course, more readily under settled conditions.

The industrial advantages of combination are ably pointed out. The general view over here, however, is more in the direction of individual effort, the stimulus of competition being considered necessary to prevent the stagnation of an industry due to restrictions imposed by a universal control which finds its interest leads it to play a waiting game.

The Straight Tip.

Electrical contractors have suffered for long, and will continue to suffer, from the evil which is exposed from time to time in such communications as that which we print below.

It is difficult to see what a corporation, or a company for that matter, can do to stamp out the cult of the "little bird" effectually, but it is certain that a great deal more can be done towards this end than is done now. The trouble is to make honesty the more attractive policy, that is to say, more lucrative than the policy of shady tricks, but it is not easy to recruit as canvassers the class of man which is free from the liability to be tempted by a double commission.

In Dublin the practice of giving exclusive and early information to favoured contractors has been notoriously rife for years, but it will be understood readily that the Electric Lighting Committee has found it a very delicate matter to handle, and it is doubtful if aggrieved contractors have taken their tales to the proper authorities any more readily than people usually do in these and similar cases. A public scandal is apt to be concealed and nursed in the minds of a few for a long time before it bursts all bounds, and is forced for the first time officially under the notice of the only persons who can do something to exorcise it.

The Dublin Committee has struck a blow at the hydra, but it must bear in mind that its sword is not keen enough to strike off all the heads of the beast. Constant vigilance and a strong right arm are needed if this unclean monster of semi-demi-official favouritism is to be killed, not merely scotched and thrust under the surface again.

January 24th, 1910.

Dear Sir,—I am desired by the Lighting Committee to say that it was with very great regret they received recently complaints to the effect that the canvassers attached to the Electric Lighting Department have been in the habit of recommending certain selected electric wiring contractors to prospective consumers. The complaints were very carefully investigated, and the Committee are sorry to find that there was some general ground for them, though the Committee hope and believe that this regrettable conduct was due to thoughtlessness rather than to any interested motive.

I am requested to inform you, however, that the Lighting Committee have now definitely notified the canvassers that all contractors on the official list must be treated with the strictest impartiality, and that any breach of this order will be visited with immediate dismissal.

The Committee desire me to add that should you have any cause of complaint, they will esteem it a very great favour if you will communicate at once with them.

Fred. J. Allan, *Secretary*.

Dublin Corporation Lighting Committee.

THE ELECTRICAL EQUIPMENT OF SMITH'S DOCKS, NORTH SHIELDS.

The equipment of a ship-repairing works presents many points of similarity to that of a shipyard proper, but there are also many points of difference. The North Shields branch of the Smith's Dock Co. consists of three dry docks, ranging from 300 to 435 ft. long, and two pontoon docks, 365 ft. and 435 ft. long respectively. In addition, there is an extensive shipyard for building steam trawlers, medium-sized cargo boats, and other small vessels, while, across the river at South Shields, a further set of three dry docks for repairing purposes is in operation. Increasing business recently suggested to the firm the removal of the shipbuilding branch to Middlesbrough, where extensive new works are now in operation, and the devoting of the space thus left at North Shields to greater repairing facilities, a 600-ft. graving dock being in contemplation.

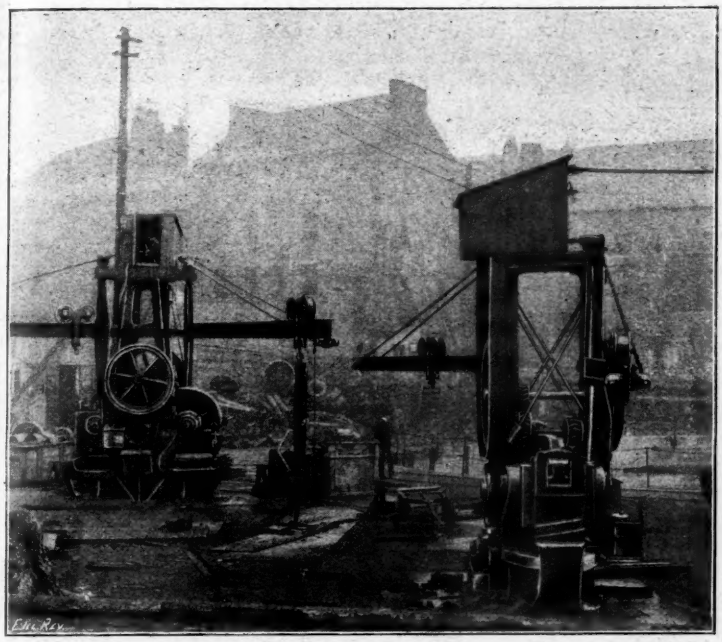

Fig. 1.—Punching Machines with Westinghouse Motors fixed above.

The company is of very old standing, being really an amalgamation of Messrs. T. W. Smith and Messrs. H. S. Edwards & Sons, founded in 1782 and 1786 respectively, so that it carries on one of the oldest ship-repairing industries in the kingdom, although it has been known by its present name only since 1891. The great success of the firm is due to the fact that its policy has always been to keep up with engineering progress, and even before the amalgamation took place, electricity was being used to pump out one of its floating pontoons by the firm whose name is still retained by the company. This was before the days of municipal supply, so that a private plant was put down to operate the pumps electrically. Last year, on the advice of Mr. C. W. Fairweather, consulting electrical engineer to the firm, it was decided to change over and take an electrical supply from the system of the Tynemouth Corporation Electricity Department. The steam equipment, fed by three marine boilers, was scrapped, such hydraulic and pneumatic systems as were in operation were operated electrically, and, wherever possible, without incurring too much expense in changing over existing electrical machinery, a three-phase supply was introduced. Where this was not possible, a D.C. supply was taken from the town mains, the firm's old dynamo being dismantled. The practical effect on the time operations of the firm, owing to the almost unlimited amount of power available from the central station plant, is that all three docks can be used at one time—that is, three ships can be docked together, whereas it was formerly necessary to hold one ship back in order to spread the pumping over a longer period and thus keep down the load.

Two systems of distribution are provided, viz., a D.C. supply from the Tynemouth Corporation main station (which is now equipped for transforming the high-tension three-phase bulk supply from the Newcastle-upon-Tyne Electric Supply Co. to a three-wire low-tension D.C. distribution at 440 and 220 volts) and a three-phase 40-period supply The sub-station for this latter supply is erected on the premises, and the three-phase motors which are operated from this centre are, with the few exceptions mentioned later, of the squirrel-cage induction type. In connection with the pumping of the two large graving docks mentioned above, a pump-room is installed on the pier between the docks, the whole of the plant being underground.

The installation consists of two main twin horizontal Worthington pumps, each of 16 in. diameter, direct driven by a 150-H.P. Westinghouse A.C. motor, an 8-in. drainage pump, operated by a 25-H.P. Westinghouse A.C. motor, to drain the docks after pumping, whilst for ballast purposes a 17½-H.P. A.C. motor operates an 8-in. delivery ballast pump, and a 2-H.P. A.C. motor drives a small priming pump.

Space is economised as much as possible by placing the centre line of each combination parallel to the axis of the pier, and inverting the relative position of the motor and pump in one set, so as to bring the two sets close together. The lighting for this room is taken from one phase to earth.

It has been found possible to empty the smaller of the two docks completely in an hour and a half when using both sets of pumps, while the larger one takes two to two and a half hours, according to the size of the vessel which is being docked. For opening and closing the gates of both these docks, a capstan, made by Messrs. Clarke, Chapman & Co., is used, the arrangement of chains being such that one of

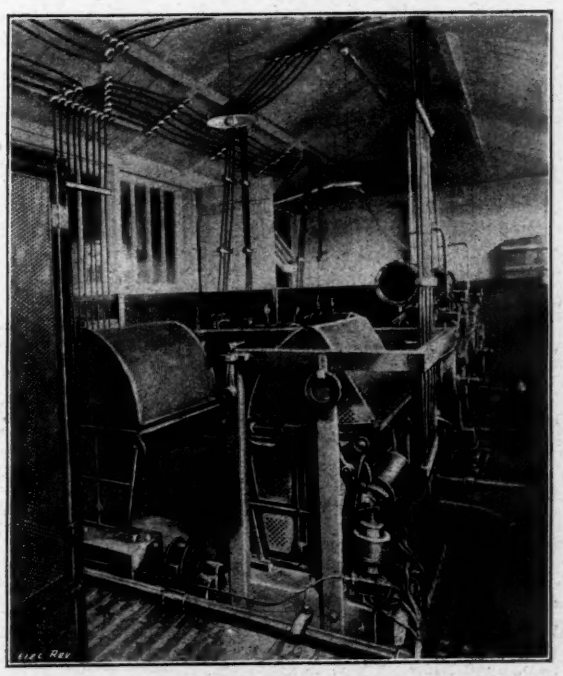

Fig. 2.—Automatic Switchgear for Controlling Compressor Drive.

these passes through an eye on one gate to a bolt on the other, the tension of this chain, therefore, drawing both gates close together. Another chain, divided at a point along its length into two separate chains, is suitably arranged for throwing the chain wheels into and out of gear with the drive, which is accomplished by a 25-H.P. slip-ring motor.

In connection with these docks, a Ransomes and Rapier jib crane of 15 tons capacity, at a radius of 45 ft., is also in operation on the three-phase system, having motors of 30, 20, 20 and 10-H.P. for lifting, derricking, slewing and traversing respectively. On this pier is also a fitters' shop driven by a 30-H.P. Westinghouse motor. The supply for this crane is taken from a plug box some 10 yards away through a flexible armoured cable and fed through a hollow vertical

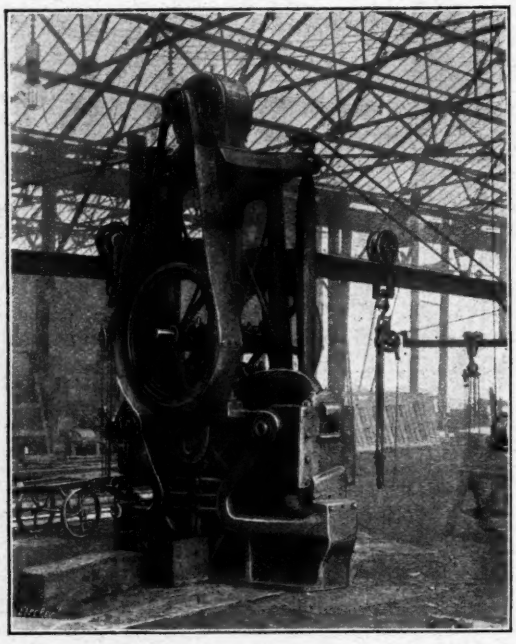

FIG. 3.—PUNCHING AND SHEARING MACHINE WITH MOTOR DRIVE

shaft, on which the crane superstructure rotates, to slip-rings, from which it is taken to the switchboard. Each gear is equipped with an electromagnetic and foot brake for use in cases of emergency.

The three-phase supply is also used for operating 20 and 15-H.P. Westinghouse motors on punching machines erected in the open for working large plates, the motors being mounted on the top of the machines and supplied by an overhead pole construction, which is clearly shown in fig. 1, and two 65-H.P. Westinghouse slip-ring motors for driving air compressors, which supply power for working pneumatic tools for the ships under repair in the docks. Each of these slip-ring motors is controlled automatically by a liquid starter, operated by a small motor which is thrown on and off the line by a switch controlled by the air pressure in the air receiver. The pressure at which this switch operates can be adjusted by altering the weights attached to the movable blade of the switch. Fig. 2 gives a view of the air-compressor room, and shows this automatic gear very plainly.

A D.C. supply, of which there are four services direct from the Corporation mains, is used for the motors driving the fans for the coppersmiths' and blacksmiths' hearths and machine tools; and also for the flame arc lamps which are used throughout the yard for outside lighting and for the enclosed lamps for inside illumination.

In the shipyard, which forms the middle section of the area occupied by the firm, a number of tools are driven by D.C. motors. Among the heavier machinery may be mentioned a joggling machine driven by a 40-H.P. D.C. motor, a large punch and shears driven by a Westinghouse D.C. motor, shown in fig. 3, and large mangles for straightening plates operated by a 17-H.P. D.C. motor. As the load on the last machine is very fluctuating, a large-scale ammeter is installed in view of the man using the controller, so that he can regulate the rate at which work is being done. A fine plate-planing machine, 22 ft. in length, is driven by a 30-H.P. Westinghouse A.C. motor. Close to this machine is a drilling and counter-sinking machine for working on the plates, driven by a 7½-H.P. A.C. motor.

An interesting feature in the shipbuilding department is the erection of a main switchboard, controlling the power circuits, on a platform 30 ft. above ground, and closed in from the shop by glass windows, so that the operator has a full view of every machine in the department. Double-pole fuses and switches are provided for each circuit, together with main switch and fuses, and the necessary voltmeters and ammeters.

At the entrance to the pontoon department is situated No. 6 graving dock, which is used for docking the smaller boats. The pumping equipment, which is capable of emptying the dock in about 2½ hours, is contained in an underground room at the side of the dock, and consists of a centrifugal pump, with a capacity of 6,000 gallons a minute against a head of 26 ft., direct connected to a 70-H.P. Westinghouse vertical A.C. motor operated by an auto-starter, and small draining and priming pumps direct driven by A.C. motors.

One of the main features of interest in connection with the pontoon department, which also forms one of the outstanding features of the works as viewed from the river, is a travelling jib crane on the wharf side, which is used for such purposes as placing very large propellers, &c., on boats lying alongside the quay. It was constructed by Messrs. Ransomes & Rapier to lift 25 tons at a radius of 43½ ft., and is operated by four D.C. motors—40 H.P. for the hoist, 20 H.P. for derricking, 10 H.P. for travelling and 15 H.P. for slewing.

An extensive fitting shop is in operation in connection with the pontoons, some of the machines, such as lathes and drilling machines, being of considerable power. Amongst these may be mentioned a four-tool lathe with a bed taking work up to 40 ft. in length, and a planing machine of 10 ft. by 4 ft. These two machines, together with three other lathes, are operated by a 50-H.P. Westinghouse induction motor, which also drives, by means of a rope belt and friction clutches, a 20-ton overhead travelling crane. The smaller machines in this shop are driven from a line shaft by a 30-H.P. Westinghouse motor, whilst the joiners' shop, which is used for ship repairing work, is operated by a 15-H.P. Westinghouse motor.

In the hydraulic house, adjacent to this department, is installed a pump for working the accumulator for the hydraulic system of the works, which is maintained at a pressure of 900 lb. per sq. in. The pump is driven by an 85-H.P. Westinghouse slip-ring motor, which, with the exception of the air compressor plant, one capstan, and one crane equipment is the only slip-ring motor in the place. It is provided with an automatic liquid starter for starting against load, being controlled by the rise and fall of the accumulator. A 50-H.P. Westinghouse A.C. motor drives the compressor for the pneumatic hammers and rivetters in the docks, which are supplied at a pressure of 40 lb. per sq. in. In this connection it may be mentioned that the hammers in the blacksmiths' shops were recently converted from steam to pneumatic drive. The blacksmiths' department in this section comprises a series of 20 fires, the blast for which is maintained by a Roots blower driven by a 10-H.P. Westinghouse A.C. motor. Two other motors, each of the same capacity, operate punching and shearing machines, and a mangle and drilling machine in the high shed (pontoon department). There are, amongst other heavy machinery, a fine set of rolls by Messrs. Hugh Smith & Sons, capable of taking plates up to 30 ft. in length, driven by a 55-H.P. D.C. motor. In this section the same arrangement of main switchboard is adopted, it being carried on an elevated gallery at such a height that the whole of the machinery can be seen at one time by the operator, isolated from the dirt and dust of the shop by glass partitions. For the purpose of pumping out pontoons Nos. 7 and 8, a series of four and eight pumps are respectively installed, each pump having a delivery pipe of 18 in. diameter, and being operated by a 60-H.P. Westinghouse A.C. motor. It may be taken that any

further extensions will be carried out by means of three-phase power.

The whole of the A.C. electrical equipment, consisting of three-phase motors, auto-starters of the oil-immersed type, controllers and automatic liquid control and electromagnetic brake gears, was supplied by the British Westinghouse Electric and Manufacturing Co., Ltd. The wiring was carried out by Messrs. Warren, Beattie & Co., of Middlesbrough.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Protection and the Electrical Industry.

Mr. J. S. Hecht writes in your issue of January 14th on the question of our economic position with all the assurance we are accustomed to find in ignorance and in Tariff Reformers.

He crushes Cobden, and, it is to be presumed, the whole illustrious line of statesmen and economists who have accepted the policy of Free Imports as the best *practical* policy, by a loose reference to standardisation and to repeat work. His next two propositions contradict each other :—

1. Free competition within the tariff wall may be relied on to keep down prices.

2. Within the tariff wall of Germany, it was found necessary to form rings to prevent free (insane) competition.

After further matter so loose that it cannot be followed, and therefore cannot either be praised or blamed, he comes down to figures.

In his figures we find an old acquaintance, the "accounting fallacy," which has done duty in so many letters to so many Tariff Reform Editors for the past six years.

Every business man knows that it may be good policy to sell old stock at slaughter prices rather than scrap it altogether, provided it does not interfere with sales in his ordinary market at the full price.

He likewise knows that it is bad policy to have such a surplus unsaleable at a profitable price, if any ordinary business precautions can prevent its accumulation. The success of a sales policy is measured by the smallness of the stock carried in proportion to the annual turnover.

Now, Mr. J. S. Hecht advocates the policy of deliberate over-production for the normal market, with the aim of launching the surplus on the export market at unprofitable prices.

An interesting result of this policy is that the greater the export trade is in proportion to the home trade, the less are the profits of the industry concerned, on a given output. Any accountant will assure Mr. J. S. Hecht that the best policy for such a protected industry is to form a ring, limit the output to the requirements of the protected market as nearly as it can be estimated, and limit the capacity of the factories to such a point that the home demand keeps them running at their most economical output, or as near to it as possible.

After this point has been reached, every factory erected by the ring will be run at a dead loss, for either the whole of its production is exported at unprofitable prices, or, if some be sold in the home market, it will displace an equal proportion of the products of other factories, and this displaced portion must be sold abroad at unprofitable prices.

Hence, in either case, the ring will have to dispose of the whole production of the new factory at a price which will not pay any return on the fresh capital invested in it.

Further, the ring must coerce or persuade independent manufacturers from entering this line of business, and from building a new factory.

The struggle usually ends either in the complete ruin of the new factory by local underselling, or in the new factories capturing a disproportionate share of the trade at prices just lower than those fixed by the ring.

This in turn usually leads to the new factory being bought up by the ring at an inflated price, and the whole of its production either being directly exported at unprofitable prices, or if sold in the home market, forcing an equivalent amount of the old factory's production abroad, on the same unprofitable terms.

So far for the primary economic actions and reactions set up by a tariff. Equilibrium is reached when the loss on exports reduces the profits on the home trade to a point that ceases to attract fresh capital.

Let us consider its secondary effect on the free market.

It is clear that it will affect adversely the competing trade in the free market, directly by taking away business, and indirectly by lowering prices.

On the other hand, it will stimulate the consuming trade in the free market, by the advantageous prices directly, and indirectly by the wider range of technical and manufacturing ability placed at the disposal of the buyers.

At the same time it will discourage and depress the consuming trades in the protected market, both by raising the price and by limiting the range of design and manufacture open to the buyer.

Let us now take the secondary reactions on the trades supplying raw and partly manufactured materials to the protected trade under consideration within the tariff.

These trades will be stimulated in proportion as the increase in the consumption of the protected article in the export market exceeds the restriction caused by high prices in the home market.

Again, in the free market, the corresponding trades will suffer or gain according as the increase of consumption caused by low prices exceeds or is less than the imports from the protected country.

It is clear that these actions and reactions, advantageous and disadvantageous, run backwards and forwards through the whole business fabric of every nation engaged in international trade, becoming, at a very early stage in the investigation, far too complicated to be capable of anything like quantitative analysis.

The general conclusion might be ventured on that, if other economic forces were eliminated—as, of course, they never are in any real case—the production of raw and semi-finished articles would be stimulated in the protected country at the expense of the free market, while the finishing industries, such as superfine spinning, and the complex industries, such as shipbuilding, for which every kind of manufacture is raw material, would be stimulated in the free trade country at the expense of the protected country.

But in the absence of any possible quantitative analysis of economic gains and losses in any particular case it is necessary to fall back on general theoretical conditions. After all, as every banker knows, trade flows in closed circuits, driven along at each stage by the producing energy of the nation behind it.

Exports in the widest sense of the word *must* be paid for by imports in the widest sense of the word.

If resistance be offered by a tariff to the return flow of the import trade, there is created at once a back force which reacts through the intricate network of trade channels until it is felt with undiminished force restraining the exports of the nation that imposes the tariff just as certainly as if the equivalent export tax were placed on the out-going goods at the other end of the trade circuit.

Not men of small minds alone have failed to realise that economic forces are beyond analysis in detail.

Bismarck was misled by the rapid progress of the United States into the belief that a case had been established by actual experiment for a protective tariff.

But who can separate from the effects due, in this case, directly to tariffs, the effects, certainly much greater, of the successful and final settlement of the great controversy between South and North, the possession of unprecedented internal resources over a free trade area of millions of square miles, and the general progress in railway transport so vital to the development of a continent?

That Bismarck's grasp of foreign trade was not accurate is shown by the ridiculous blunder he made in fixing German coinage at 20·4 marks to the £1, under the delusion that on every transaction with England Germany would gain an appreciable portion of the odd 0·4 mark.

It may be supposed that Bismarck's success in guiding political forces of the greatest magnitude made him more

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prone to the belief that he could directly control the flow of trade.

The establishment of free trade within an area not, indeed, comparable with that of the United States, but densely populated with the most docile, disciplined, and highly educated people in Europe, was the real basis of Germany's economic success.

That protection in itself is powerless to help a nation is shown by the fact that of all the protected nations of the world, only two press us hard in manufactures, and these are the most similar in character and education to ourselves. A greater mind than Bismarck's made more lamentable errors in an attempt to control economic forces.

The great Napoleon sought to ruin England *by exporting corn to her in time of famine.* Great constructive originality of mind seems to be the very worst qualification for the patient acceptance and analysis of scientific rules.

Goethe, the greatest creative mind in Europe of his day, could only assail Newton and his successors with abusive epithets on the subject of the spectrum.

Had there been personal profit to artists in Goethe's artistic views, it is not inconceivable that rejection of Newton's geometrical theory of light might be supported by a spectrum reform commission.

With such illustrious examples of aberration from the official findings of the body of scientific opinion, it is impossible to blame business men for showing a certain narrowness outside their own circle of business.

In fact, the analytic turn of mind so necessary for examining all sides of a question, is a positive hindrance in business, by rendering its possessor incapable of the pertinacious one-sided egotism required for pushing a business connection. Both kinds of mind are required for carrying on the business of the country.

The professional economist, or statistician, would never dream of laying down the law to a business man on questions of detail administration of his business.

Let the business man in turn refrain from rash incursions into the domain of the economist. Let him specially beware of taking analogies from his own business, and applying them to the general course of trade in a fully-developed manufacturing country.

What man could undertake, from his own business experience, to go into the details of the costs, technical, sales and works departments of each of the 60,000 factories in the British Isles, and then frame a tariff which would in no case encourage inefficiency—at the expense, of course, of efficiency?

Who could decide when a trade languishes from inefficiency, when from irresistible economic changes, and when from "unfair" competition?

It would be quite as hopeful a task to drop pebbles into a mill-pond and then attempt to describe the waves of the sea in detail.

There has still to be added the increased cost of the Customs service, the certainty of wire pulling and log rolling, if not of open corruption.

There is the political impossibility of taking off a tax found to be harmful, after millions of money have been invested on the strength of the tariff clause.

It is certainly fascinating for all of us to dabble in theoretical experiments on the immense economic forces of the world.

In theory we are all confirmed tariff reformers. We dally with visions of Germany suffering dreadful economic defeat, not by hard study, not by hard work, but by a few lines in a tariff bill.

In our dreams we see the tariff wall of the United States breached by drastic retaliation, and British manufactures pouring through in an irresistible flood.

In practice it is safer and wiser, and, in general, more profitable, to avoid protective tariffs altogether.

A. R. Low.

Loughborough, *January 26th*, 1910.

In these days of world-wide competition, when most manufacturers are pleased to get 2 to 3 per cent. net profit on sales for export, the fabulous profits of your correspondent "Ex-communicated" will cause much surprise. He says:—

At the present time I export to all foreign countries, and I am forced to pay the duties on my goods or make an equivalent reduction in price to my customers in these countries.

As the average import tax on manufactures entering Germany is 25 per cent., entering America 73 per cent., and entering Russia 131 per cent., and as your correspondent exports his mysterious manufactures to all foreign countries, and pays such enormous foreign charges, what must his net profit be, for instance, on his trade with Argentina, where most electrical manufactures enter free of duty?

Every manufacturer knows that it is not usual for merchants who have export orders to place, to specify the market when asking for prices. Export prices are usually quoted f.o.b. British ports, and very few manufacturers trouble to inquire what foreign Customs duties amount to, but make the same price f.o.b. for all markets, and English goods always get the most-favoured-nation treatment.

"Ex-communicated" should really send such wild statements to the half-penny Press.

C. E.

I cannot refrain from correcting the ridiculous statements made by Mr. Hecht in your issue of 21st inst. Mr. Hecht commences his argument by saying:—"Let us assume a manufacturer is doing a turnover of £500,000 and that the foreigner imports £500,000." In other words, the value of goods imported into this country is equal to our total production. If we refer to the official tables published in the Electrical Review of January 28th we shall find that the value of imports of electrical manufacture equal £1,600,000, our total production being approximately £12,000,000. Mr. Hecht's argument is consequently valueless, and the conclusions he arrives at are grossly misleading.

In the tables mentioned above, we also see that the value of goods exported equals £3,400,000, which figure is just over twice the value of goods imported. Apparently, therefore, for every £100 worth of goods "dumped" into this country we have the audacity to "dump" over £200 worth abroad.

If we put a 10 per cent. duty on all manufactured imports, other nations will retaliate with higher duties against our exports, and we shall be hit twice as hard, seeing that our exports are double our imports.

Mr. Hecht admits that a 10 per cent. duty will raise the price of the manufactured article in this country by 10 per cent.—*i.e.*, 10 per cent. on £12,000,000, which is £1,200,000, and this sum the country will have to pay. By keeping out foreign imports we shall undoubtedly lose the same value of export trade. Employment will therefore not be improved, and the cost of living will be raised. There will also be a dead loss to our shipping trade, as the goods are neither imported nor exported.

Where, therefore, is the advantage of protection?

Free Trader.

Under the above title you published in your issue of January 21st a letter from Mr. J. S. Hecht, and under another title, but allied in subject, a letter from Mr. A. B. Anderson. Some of your readers have continued the correspondence, though in the former case hardly in the direction that I anticipated, or in the latter case so fully as the subject matter of the letter deserves.

I am well aware of the inutility of controversy with one who at the very commencement of his letter alludes to the "fallacies of free trade or free imports," but I hope, nevertheless, that I may be permitted to call attention to the fact that all Mr. Hecht's figures are entirely dependent on the assumption that a modification may be made in our fiscal system, which will secure to us our home market without reducing the demand in that market, or affecting our capacity to retain neutral markets.

Your correspondent expresses the view that "in no class of manufacturing does repetition and standardisation play such an important part" [as "in the electrical industry"], and he proceeds to ask "what did the late-lamented Richard Cobden know of such details? How could he foresee, and

there are no signs that he did, that providing a manufacturer were sure of his own market, he could put down the requisite plant to manufacture on a large economical scale, and thus be in a position to supply his goods in an unprotected country at a lower price than the home manufacturer, and yet make a profit"? The manner in which Cobden's name is introduced serves to convey the impression that your correspondent holds the view which many others hold—*i.e.*, that "the late-lamented Richard Cobden" was a sound adviser in his day, but his day is over and changed conditions require a change in policy. If there be any disciples of Richard Cobden who fail to recognise that policies require to be changed with changed conditions, they are but very poor worshippers of the Apostle of Free Trade, for the recognition of that very principle was a necessity for the propagation of his crusade. He said: "at certain periods in the history of a nation, it becomes necessary to review its principles of domestic policy, for the purpose of adapting the Government to the changing and improving conditions of its people." Nor did he limit these considerations to domestic policy, for he held also that "it must be equally the part of a wise community to alter the maxims by which its foreign relations have in times past been regulated, in conformity with the changes that have taken place over the entire globe." These words were not written with reference to his Free Trade propaganda, but they serve to show his catholicity of view and are directly applicable to manufactures, trade, and commerce which affect both domestic and foreign policies. A more general recognition of these views of Cobden's may perhaps serve to lessen the use of the word "Cobdenite" as a term of reproach, and to bring to a clear issue, by calm reflection upon ascertainable facts, the existing divergent views on fiscal policies.

In anticipation of that review of existing conditions which Cobden recommended, your correspondent prejudices the inquiry by suggesting that present methods of manufacture are such as Cobden did not know, and could not be expected to foresee, and that their existence is incompatible with that freedom of trade, or freedom of imports, which he was instrumental in obtaining. Of course, the practical question is not what someone in the past would consider the most advantageous course under existing conditions, but what the evidence now shows to be desirable. Nevertheless, it is so often suggested that the manufacturing conditions of to-day differ widely from those in operation in Cobden's time, that I may be excused a brief reference to that point. On another occasion and before another audience, I alluded to the methods of production "by means of labour-saving appliances and a highly systematised sub-division of labour, which is sometimes assumed to be very modern, but which is really of very respectable antiquity." Cobden was intimately connected with manufacturing conditions. The development of the factory system had been reached before his political career began. Babbage's work "On the Economy of Machinery and Manufactures," was published in 1832. It records some of the results at that date and contains the principles which govern the subsequent developments. There is ample evidence that Cobden was well informed of the conditions existing in his time, and of their trend. How far he foresaw their development it is impossible to say and not particularly profitable to speculate upon, since it should not weigh with us in the least if change were essential.

Protection to an individual, a class, or an industry, is so obviously to the interest of that individual, class, or industry (at least for the moment), that discussion upon it becomes futile. The butcher, the baker, and the candlestick maker may be impressed with the value of Protection by dwelling unduly on its results for himself, and not realising sufficiently its effect when all participate. Hence all sectional views are liable to be misleading, and in that case the aggregate of sectional views must be misleading also. Protection to the electrical industry will be attained contemporaneously with Protection to all industries, or not at all. It follows that we who are concerned with that industry, must take a wider view, must look not merely at direct, but also at indirect, results before reaching a conclusion on the matter. This need for the consideration of indirect results is exemplified in Mr. Hecht's reference to the coal tax. In his view the encouragement of the export of coal is analogous to the exportation of irreplaceable works of art. Mr. Hecht uses the coal tax only as an illustration; the re-imposition of the tax, however, would clearly have his support. But he is writing in the interests of the electrical industry, and on behalf of a crusade which is expected to reduce unemployment, and to benefit the country by taxes paid by the foreigner. A canvas covered with pigment by a deceased old master may be worth £50,000. The nation that does not value its old masters is in a bad way. I advocate keeping them. But from the points of view of employment, and of the electrical industry, how does the old master compare with a similar value in coal? If anybody cares to work it out the figures may be reached with some precision. There is a room set apart at South Kensington for Raphael's cartoons. What is their capital value? What is their share of the administration charges and of the employés of the museum? And what is the percentage of the latter to the former? What is the capital cost of lighting the Raphael gallery, and what is its share of upkeep and consumption of current? On the other side, how much labour is employed in winning coal of equal value? How much is spent on land transit to port of shipment, and how much paid to English shippers in English ships to destination? When your correspondent has done these sums, he may perhaps point out the benefits to be obtained by the electrical industry from the imposition of a tax which he intends shall diminish the production of coal. The application of electrical working to mines is a promising field. A society or institution has recently been formed especially for its encouragement. Will its efforts be assisted by the reduced prosperity of the mines? And are the electrical interests in the north of England and the south of Wales, the sources of their supplies in the Midlands, or the Metropolis, to suffer no loss by reason of the reduced demands which a dislocation of trade must inevitably produce? As a compensation for this dislocation there is the tax on export. I share Mr. Hecht's laudable desire to tax the foreigner, but I want to be sure that I am doing it. To satisfy me in this case, I should need to know how much coal is exported by Englishmen for the needs of England's world-wide shipping, and what is the indirect value to the shipping interests of the coal *bonâ fide* purchased by the foreigner. This would show how much of the tax is a transfer from one English pocket to another, and how much is income from outside sources.

To deal with the problem of Free Trade and Protection on the basis of the modern developments of manufacture in quantity so as to produce an impression on a Protectionist mind is difficult. The difficulty is increased by the conditions which the Protectionist lays down, that examples must be concrete examples, and arguments must be entirely free from Free Trade theories. By Free Trade theories is usually meant any theory based on economic laws and the natural flow of trade and commerce. Concrete examples must be of the "eye for eye" and "tooth for tooth" kind. It is but adding insult to injury to remind a manufacturer of switches that if he has no Protection, neither has the manufacturer of iron, and yet it may be that the switch maker is doing excellent business on the Tyne or the Clyde as a result of the free import of iron. It is no consolation to a lamp maker to be told that an importation of lamps is part payment for somebody else's exports of cotton, and yet, through his agents in Lancashire, he may be deriving considerable benefit from the success of the cotton industry.

The importation of any article may arise from one of three causes—(1) it may be a new article of commerce; (2) it may be more adapted to the purpose required; or (3) it may be cheaper than an article procurable in the home market. Under Free Trade, a purchaser would exercise his judgment with a view to obtaining the best results in the expenditure of his money. Under Protection he would (1) pay more for the article than the maker was willing to take for it, or lose the use of the article until it was manufactured in England; (2) adopt a less satisfactory article of home manufacture; or (3) incur an expenditure larger than necessary. In every case there would be a loss of efficiency or a waste of money, with a possible loss of employment in use or in allied trades. On economic grounds, therefore, there can be no justification for interfering with the free choice of

the purchaser. Nor is it claimed that protection in such a case is economically justified. The justification is sought either in retaliation for similar treatment by the exporting country or indirect benefits arising from the additional expenditure. Fiscal retaliations have not been the most pronounced successes even in hopeful cases, and they are the less hopeful in the case of countries dependent on commerce and manufactures rather than furnishing necessary natural products. It is merely a question of the more profitable and expedient method. Under Free Trade a demand may be stimulated by imported supply, and manufacture undertaken when a demand has been created. In theory, other things being equal, the same article should not be manufactured in two places. In practice, of course, other things are not equal, and the manufacture of similar articles in more than one place is commonly undertaken.

In protected countries the manufacture is undertaken compulsorily. In Great Britain voluntarily. It is true that there is a minimum output below which manufacture in quantity is either impossible or uneconomical, and the fears which are sometimes expressed that with the foreign benefit of a start in any particular trade, the supply may be indefinitely lost to us, should not occasion any surprise. Nor should such fears be allowed to degenerate into panic, resulting in our refusing a certain present gain to avoid a problematical future loss. To refuse to purchase an article which we can profitably use because it is part of the surplus product of another State, is to refuse a benefit. It is no answer to say that that State refuses a similar benefit from us.

As I have said above, it is true that a certain minimum output is essential for profitable manufacture. It always was so, and presumably always will be so. The only difference between the present and the past is one of degree. The minimum number for profitable manufacture will vary with the circumstances of the place and type, and it is my impression that the number will be lower in a Free Trade country than in a Protected country. If my impression is correct, there is less reason to fear the loss of a trade through purchase of foreign surpluses, provided those purchases are useful and economical. In other words, with Free Trade we can catch up. But that is no reason for not being wide awake!

In contradiction to the view I have above expressed of the probable early and profitable manufacture of an article under Free Trade, let me consider the possibilities under Protection. The purchaser of an article is to be sure of no increase in price by reason of internal competition. Mr. Hecht rather naively says: "In protected Germany the manufacturers had to form groups to stop the insane internal competition." Quite so. And a similar degree of sanity after temporary aberration may be expected in England. In Protectionist America also, the President finds it necessary to send a message to Congress bearing on the need of special legislation to deal with trusts, which have been alleged to seek advantages for themselves against the interests of the public generally. I offer no opinion on either of these matters, which relate to the domestic policy of other nations. But it would be unwise to shut our eyes to the tendencies in Protectionist countries for what is called the organisation of industry or the further tendency to internationalisation of that organisation.

Now let us assume that England adopts Protection and follows the precedent your correspondent mentions. There will be insane competition, followed by saner combination. It will be apparent to the combination, and similar combinations in other countries, that the manufacture of identical articles in more than one civilised State is not in accordance with the laws of economical production; a balance would be struck between the duties payable and the economies possible from concentration. Other things being equal, the best country to manufacture the article in would be the country having the highest import duty, since manufacture elsewhere would involve the payment of larger sums for duties in that country. Hence, in order to retain the manufacture of an article, it would be necessary for us to place our duties high, not low. This, of course, is a conclusion in the nature of a *reductio ad absurdum* at present, but when adopting a new fiscal system, it is well to be as sure as we can be that we are not giving our descendants more trouble than we can help. Fighting qualities, under such conditions, they will certainly need, but whether exactly of the type to satisfy Mr. Anderson's ideals and mine may be open to question.

One other form of foreign competition needs to be noted, that is unfair competition. Mr. Hecht recognises the accuracy of "the Free Trader's maxim that a country should not attempt to produce that which by its resources it is unfitted to do," with the addition of the words "in *fair* competition with its rivals." There are few things more galling in business than to have to submit to unfair competition. And when that unfair competition arises from foreign sources the temptation to seek a remedy is almost irresistible. And when that foreign source is protected in his home market from our own competition by import duties, it seems but reasonable to follow suit. Of course, your correspondent's "unfair competition" is our old friend "dumping." The practical difficulty of determining when the competition is unfair will be obvious to most manufacturers, and the objection to its being dealt with by means of import duties is the very practical one that what is one man's poison is another man's meat. The further objection that dumping is a method of spoiling a trade for the purpose of subsequently "spoiling" the consumers is often urged, but lacks confirmation. My observation leads me to the conclusion that with Free Trade it need not be feared, but with Protection that and much worse is possible.

I agree with Mr. Anderson that there is a great similarity between the life of a nation and the life of an individual, but I recognise an important difference, and that is the one of duration. What to an individual may be fatal, to a nation may be but a passing complaint, and if that complaint be due to excess of riches, it ought not to be impossible to find a cure without seeking the impoverishing effects of Protection.

The main difficulty in obtaining any satisfactory result from the discussion of Free Trade or Protection centres in the indirect benefits. Arguments on indirect benefits are as necessary to one side as the other. If carefully examined, I think it will be found that the indirect benefits claimed from Free Trade are definite and demonstrable, whilst those claimed from Protection are indefinite and assumed. By "assumed" I do not mean to place Protectionist arguments at a disadvantage, because that which, by reason of the non-existence of Protection, cannot be proved as a fact, can only be assumed by argument or inference. I mean rather that these benefits are assumed to result, notwithstanding their being in opposition to economic laws—not disputed "Free Trade theories," but generally accepted maxims, such as, that water prefers to run down hill rather than up. It is the Protectionists who seek to change the existing system. The onus of proof rests on them, and they should remember that evidence which is open to the grave suspicion of improbability needs, not little, but much support.

To summarise the position as it appears to me, Protection for the electrical industry is impossible without Protection generally, and Protection generally means a reduced home market, and a seriously handicapped foreign market.

J. E. Kingsbury.

Referring to Mr. Hecht's letter in your issue of the 21st inst., which I must leave in other hands to answer, as I know it can be answered, I shall be obliged if you will kindly allow me a small space in your columns to point out that the coal export tax, of which he appears to think so highly, was most unsparingly condemned by the Royal Commission on Coal Supplies, and (which will probably have more weight with a Tariff Reformer) Mr. J. Chamberlain stated that it was his son's intention to have repealed it in his next budget. Mr. Hecht regards the export of coal as an evil, but were he a coal-owner he would in all probability object to any artificial obstacle being put in his way of selling where he pleased.

As to Brunner-Mond there is no doubt that an import duty on the class of commodity they manufacture would enrich them, but as Mr. Brunner pointed out (in a recent letter to the *Westminster Gazette*) "Why should this firm be enabled by a legal enaction to make greater profits for its shareholders, and why should the purchasers of their goods by a legal enaction be compelled to pay more for them than at present?" or words to this effect.

Troglodyte.

Protection at Last.

I "note with considerable satisfaction"—to use your own expression—that the ELECTRICAL REVIEW is at last supporting the Protectionist party. In your editorial of January 28th, you properly abandon the cruel Free Trade "cheapest market" theory, and commend the decision of certain municipalities to give preference to British manufacturers "wherever there is not much advantage to gain in the matter of price by placing work abroad." You refer generally to "the change that is coming over the people of this kingdom in desiring to keep work at home whenever in reason it can be done." That is to say, you approve of *voluntary* Protection, and you do not accept those stupid Free Trade contentions that the country must benefit by free importations of cheap foreign goods; that imports are always paid for by exports; that if our people miss an order for electrical machines or steel rails some other British trade gets an order to pay for them; and that if a mechanic is thrown out of work by unfair foreign competition, he is not injured, because all he has to do is to become a navvy, or a knacker, or a hairdresser's labourer.

Of course you and the other people who return "Free Trade" Members to Parliament are all Protectionists at heart. You know that it is foolish and wrong to give employment to foreign labour when there are British workmen idle who are able and willing to do the work. Only instead of forgetting party politics and co-operating in the scheming of a scientific tariff system to prevent this admitted evil, you salve your consciences with this feeble sentimental approval of "preference"; this irregular unsystematic spasmodic voluntary Protection, this affectation of charity, where only business common sense is called for.

Anyhow, there is hope now that you have thrown over the copy-book headings of the Free Trade Doctrinaires, that you are well on the way to the true faith.

T. C. Elder.

[Our correspondent possesses a very lively imagination, with the consequence that in his purely political diatribe, he lapses into forgetfulness: therefore it is not surprising that imaginatively and forgetfully he misinterprets our remarks. He reads into our leaderette of last week far more than appeared there; he affects to see in the sentiments expressed some new policy that he has not observed in the REVIEW before; he strains hard to read politics into a business plea for British and foreign tenders to be fairly adjudicated upon as to labour and other conditions, as well as regarding price. Mr. Elder quotes our remark urging that work be placed with British firms "*whenever there is not much advantage to gain in the matter of price by placing work abroad*," but he is careful to leave it out of account in his argument. "*Whenever in reason that can be done*" is another of our remarks also ignored by him. The Glasgow foreign tender which formed one of the incidents on which our comments were based, was only a comparatively small amount below that of the successful British firm, but in our "Contracts Closed" this week an instance is recorded of a Colonial contract for insulators going to a German tenderer at £5,300, where the British tender was £9,510. If the higher tender were accepted the Australian Commonwealth Government would have to spend £4,210 more for £5,300 worth of insulators. "Other things being equal" would hardly be applicable in a case where there is so big a difference. Our correspondent knows—and for very good reasons—that the ELECTRICAL REVIEW has always attacked specification clauses which place the British tenderer at an unfair disadvantage in competition with the foreign tenderer. —EDS. E.R.]

Equitable Charges for Tramway Supply.

Mr. Pearce's charges, as given by Mr. Yerbury, are, I believe, perfectly fair. They err on the side of modesty, when compared with "fixed charges" which I obtained about a year ago from an analysis of the Manchester figures, extending over several years, made with the sole object of getting at the true "fixed charges."

Taking a load factor of 30 per cent., the 29½ million units referred to in the paper would, neglecting losses in distribution, correspond with a maximum demand of 11,200 KW.; and the "fixed charges" per unit given by Mr. Yerbury then work out at the following annual charges *per kilowatt of maximum demand*: Coal, £0·47; oil, &c., £0·043; salaries, &c., £0·755; repairs, £0·702; rates, &c., £0·952; management, &c., £0·394; interest, &c., £4·82; renewals suspense, £1·32; total, £9·45 *per kilowatt of maximum demand per annum*.

Now, I beg to suggest that the dissatisfied tramway men have the remedy in their own hands. For, if the above are true "fixed charges," in the sense that they represent the additional annual charge to the station for every additional kilowatt of load taken on during the peak (as I believe they do), it follows that if the tramway men make arrangements to entirely remove their load during "peak" hours the station is left free to take on additional lighting load to that extent without increasing its plant or its staff; and, therefore, the station should, in equity, remit the whole or the greater part of the "fixed charge," and charge only for the units consumed, at so much per unit.

Suppose, then, that the tramway department were to put down accumulator sub-stations at various parts of the city in order to carry the above 11,200 KW. for, say, two hours (which would certainly cover that part of the power and lighting peak overlapped by the tramways), the capital cost, including buildings, would not be materially over £11 per KW., of which the batteries would represent some £7 per KW. We then have:—

	Per annum per KW.
Interest at 3½ per cent. on £11 ... ... =	£0·38
Sinking fund at 5 per cent. on £11 (including depreciation) ... ... =	0·55
Perpetual maintenance on cells at 12 per cent. on £7 ... ... =	0·84
Salaries and wages, say, half of steam =	0·37
Maintenance of boosters and buildings, say, 5 per cent. on £4 ... ... =	0·20
Total ... ... =	£2 34

Now:—

11,200 KW. at £9·45 (as above)	=	£106,000 per annum.
11,200 KW. at £2·34	=	£26,200 "
Saving per annum	=	£79,800 "

This saving would, of course, only be effected if the "running charge" remained unaltered.

From the figures in Mr. Yerbury's paper, I gather that the "running charge" is (1·04 − 0·865 =) 0·17 penny. If this is correct, then the "running charge" will be 29,500,000 units at 0·17d. = £20,900 per annum. But the battery losses may render it necessary to purchase, say, another 7,000,000 units, costing another £5,000, and we have:—

Gross saving	£79,800	per annum.
Deduct cost of extra units ...	5,000	"
Net saving ...	£74,800	"

Of course there are other factors concerned with the capital invested in feeders, &c., of which due account would have to be taken in considering the revised "fixed charge" to be levied by the station, and if the tramway load was unduly large in proportion to the station "private" load the occurrence of "abortive" peaks would have to be discounted for; but the balance in hand in the above is so considerable as to set off a great many such considerations.

I have, to simplify matters, considered only the units sold, as at the generating station, which is of course incorrect, but does not affect the result very materially. The £20,900 charge is common to both schemes, and need not therefore be considered.

My analysis of the Manchester costs disclosed the fact that when curves are plotted over several years, connecting certain annual costs per kilowatt with increasing kilowatts of maximum demand, these curves tend to become asymptotic; hence Mr. Pearce is quite right in taking these values as "fixed charges," since every added kilowatt means a correspondingly increased annual charge.

A. M. Taylor.

King's Heath, *January 28th*, 1910.

Fire Risks in Buildings.

In your leading article of January 21st, 1910, headed "Flexible Cord and Insurance Companies," you appear to congratulate the Phœnix Co. on their new set of rules.

You quote several of their rules :—

1. "Flexible cords, except when used in connection with pendant lamps hung well clear of material, must not be used in shop windows containing inflammable goods."

2. You state that the "dangers arising from the heat of the lamps themselves are also recognised. . . ."

3. Flexible cord is "prohibited" for temporary installations.

4. It is stated that "a stretching test has been introduced for rubber insulation."

Now it seems to me the proper course is to remove the danger by application of well-known principles instead of by rules and regulations.

For instance, with regard to (1) above, could not *non-inflammable* flexible be used? Why, also, is a pendant exempt? Pendants generally "short" at the lampholder, and the cord burns (if inflammable) to the ceiling. They are worse by a long way (since air has access to the cord all round) than flexible on a wall.

2. The temperature of the lamps depends on well understood causes, and if *cool* lamps were demanded, they would immediately be put on the market. Instead of this we have more rules.

3. Why is flexible condemned for temporary installations? It is used for *permanent* installations very largely on the Continent.

4. A stretching test for rubber insulation. At the present time "doctors differ" as to whether even a stretching test is of mechanical value. It is by no means admitted that a stretching test has anything to do with insulation or any other electrical property (see Electrical Review, January 28th, 1910, page 135).

Doubtless later on we shall have a complete theory connecting the elastic, thermal, electrical and chemical properties of materials. Unfortunately at present we are in almost complete ignorance as to what process constitutes metallic conduction.

At present it must be pleasing to some minds to see wiring installations carried out so as to resist "natural dangers," such as a blow from a pickaxe or total immersion in *salt* water for a lengthened period.

W. H. F. Murdoch.

London, *January 29th*, 1910.

We have been expecting to see correspondence in your paper respecting the fire, and the cause thereof, which recently occurred at Messrs. Arding & Hobbs's establishment.

The explanations given do not appear to be very satisfactory, from the electrical point of view, and a little more information would be very useful to us.

At the present time we have a large firm of drapers who are making inquiries as to the safety of their installation, particularly with regard to the lamps, as the installation itself is a thoroughly good and reliable one.

The question has arisen as to the likelihood of any of the present lamps in use, metallic, tantalum and carbon, to burst and allow inflammable goods to come into contact with them. The actual bursting of the lamp, in our opinion, is very unlikely to occur.

We shall be glad to know if any of your readers have ever known a lamp to burst except as the result of a blow, or some such cause. Also, in the event of the lamp bursting, in the case of metallic filaments, particularly the tantalum, would globules of molten metal be likely to drop, and thus start a fire, on, say, cotton wool, celluloid or silks, &c.? Naturally, each maker will defend his own make of lamp, but if there really is a danger it would be well to realise it and take precautions, so we should like your own and your readers' real opinion.

We have gone to some considerable trouble ourselves to find a shade of some description to protect the goods, which any careless assistant may hang near the lights, from coming into actual contact with the lamp, but so far have found nothing which satisfactorily meets the case.

We shall be very pleased to see the matter discussed in your paper, and think good might result to those who are engaged in installation work and advising users of electricity.

Lamps.

Comparisons.

It is with some interest that I have read the advertisement headed "Safety from Fire." I do not think that the advertisers realise that they are themselves makers of carbon-filament lamps, when they draw public attention to the fact that these are the most dangerous type of lamps (if their advertisement is correct) that are manufactured. Presumably, if the firm advertising are acting in the interests of the trade, they will immediately cease to manufacture all carbon-filament lamps, and also cease selling any other type of lamp in which they may at present deal.

In closing, Sir, I would ask whether such advertisements are calculated to improve the trade, and what the state of affairs would be if John Brown were to advertise his tungsten lamp as cooler than that supplied by James Smith, or, in other words, if every manufacturer were to lose the sense of decent trading?

Lux.

Contractor or Manufacturer?

I congratulate the writer of last week's letter under this head. He brings forward some excellent points, and it is really high time we had a true conception of the situation.

Most contractors have so far treated the abuse levelled at them with silent contempt, but the moment has arrived when it should find fitting expression.

We are so accustomed to read of the virtuous assiduity of the conscientious and unnecessarily communicative municipal official—I qualify him advisedly—in contradistinction to the able and experienced men who have won success without so much as laying claim to either title. Even the electrical Press, I fear, are becoming biased in his favour, and some of them have either jumped to the conclusion or have been tricked into believing that in asking a few business questions, I have been supporting gas against electricity. (So remarkable this seems, seeing that when, but 12 months ago, I entered the public Press in full opposition to the gas companies, the electrical Press were silent except for a cheap sneer at my expense.)

I cannot believe a particle of sincerity is to be found in the florid and high-toned sentiments so carefully and persistently put forward by the municipal official. Take the red herring away, and you will find, to use a vulgar expression, they are simply "out on the make." Few of them there are who would not be contractors if they could; but as they lack at least one essential qualification, they clamour for an opportunity to "try it on the dog." Their first proceeding is to roundly abuse the electrical contractor in the strongest and blackest terms. Their next is to prevail on their Electrical Committee to provide the necessary funds. Kindly note that these men, with scarcely an exception, always have Electrical Committees, and are not to be confused with companies' engineers. It is significant, too, that all large companies, who should be the real aggressors if any reason existed to condemn the contractor, are conspicuous by their co-operation rather than opposition. The curse of the municipalisation of electricity supply is the average Electrical Committee, who are utterly incompetent to deal with a question of which they have not the slightest knowledge, and instead of ruling are ruled by their engineer. Afraid to question him, lest perchance they should display ignorance they fain would conceal, they leave him to pursue his own sweet way; small wonder, therefore, he suffers from swollen head! Further, they are unable to detect and keep a good man when they get him, but, on the other hand, give the fullest licence and support to men seemingly devoid of principle, who seem to bluff them into any fresh enterprise their caprice or fancy dictates.

The humour of the situation is almost Gilbertian when you come to consider that the very class of contractor who is now belaboured so furiously, and made the pretext for this municipal innovation, was actually brought into being and bred by the very class of man who now so violently condemns

his shortcomings. It is painfully obvious that the municipal engineer has always had it in his own hands to reject cheap and jerry installations, if he so desired it, consequently the whole blame is his entirely. The experience of the best contractors has so far been (with, of course, the few exceptions) that the municipal engineer has been their worst enemy in conniving to get work done at a price admittedly less than the cost of proper material.

We have heard little so far of the shortcomings of the conduct of municipal undertakings in the eyes of their own consumers, although the contractor has to listen to these in abundance every day, and I fear that space does not permit me to recapitulate even a few, but I hope that the time will come when there will be a reckoning, and we shall hear something of this side of the controversy.

So long, however, as we have men of the class to which Mr. William Lackie, of Glasgow, belongs, we need not despair, for such men must prevail and remain at the head of affairs. Mr. Lackie, unlike many of his fellows, had an extensive experience in contracting before his appointment to Glasgow, and he has given his youthful contemporaries a striking lesson in commercial economy and activity by harnessing the forces ready waiting to be called into co-operative action, and securing thereby so many live canvassers and a Publicity Department worthy of the name, without cost, but to the advancement of his undertaking. Mr. Lackie's able and highly successful policy apparently has found no favour in the eyes of his less experienced contemporaries. How dare he encourage their sworn and natural enemies, and succeed, forsooth (for that is the most unkindest cut of all)! Utterly absurd! Not playing the game! Actually spoiling our fondest hopes and cherished visions of increased emoluments and fresh fields for experiment!

The simplest plan to exterminate this class of municipal absurdity would be to give them, say, two years of contracting entirely on their own responsibility. Two years would be the limit, for I am confident 90 per cent. of them would not last that time in a state of solvency.

I know full well that these remarks will bring a lot of abuse, possibly from small, remote and scarcely known stations, but that does not deter me; I like it, it whets my appetite for more, and it proves that my points have gone home.

Duncan Watson.

London, W., *February 1st*, 1910.

The Publicity Department.

Your correspondent "X" touches upon an important subject in his letter published in your last issue under the above heading. His observations on the advertisements of electrical manufacturers are, perhaps, unduly severe, but there is much truth in what he says. It is a fact that British manufacturers of electrical goods are not as fully alive to the importance of their advertising matter as are their competitors in America and Germany. If they were, we should probably hear less of the need for Protection.

Manufacturers should regard their advertisements as their best travellers. A human traveller, however energetic, can only call upon a limited number of probable customers in a week. An advertisement in a widely circulating journal constitutes a paper traveller, which will appeal to thousands and find its way into places that the human traveller would probably never think of going to.

Would any sensible employer think of sending out a traveller badly dressed and inadequately informed as to the qualities of the article he has to sell? Then, if it is important in the case of the human traveller, how much more important is it that the paper traveller should be carefully prepared and well equipped with convincing arguments likely to bring good results.

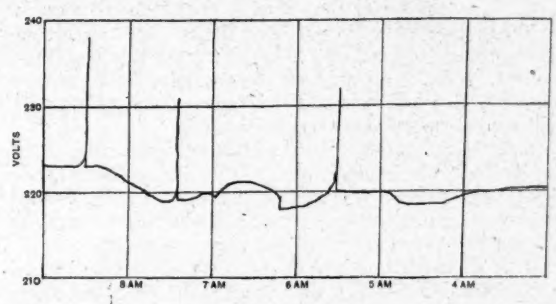
Your correspondent rightly condemns the would-be humorous advertisements, of which there are too many in the pages of the electrical journals. But that they will disappear in time is certain, simply because they are bad advertisements. A traveller is not a good traveller who only succeeds in making a probable customer laugh.

S. Davis & Co.

London, E.C., *January 31st*, 1910.

Mysterious Kicks.

I should be glad if any of your readers could give me the explanation of the kicks shown on the voltage record below. The chart was taken during the morning load, when only the station battery was in circuit, and the voltmeter was fixed in a consumer's premises served with a tail end of ·05 three-core paper cable, laid solid and branched off a ring cable, and



situated about 4 miles from the works. The station volts are never above 230 a side, and usually are about 227 during the morning. The kicks are not, I think, due to vibration or blows on the instrument, as they are always in an upward direction, and have been recorded on other premises in the same neighbourhood, and at all hours during the night, after the time when the engines have been shut down, and the battery has taken the load.

X.

The Price of Electricity.

I have taken part on three occasions in discussions at meetings of the Institution of Electrical Engineers upon the subject of the principles which should influence the price of electricity,* one of these occasions being the meeting on Thursday last, when Mr. Yerbury's paper was under discussion.

I gathered at that meeting, I think correctly, that the views I put forward are neither acceptable to, nor of interest to, other engineers concerned with this aspect of the question of electricity supply, and the best course for me to take under such circumstances is to "shut up." This I propose to do; it is the function of a crank and not of a sane engineer who desires to contribute his quota towards the elucidation of truth, to force his ideas when or where they are not welcome. I do not mean to imply in what I say above that my contributions have not been treated entirely courteously, but I have not gained the active attention of any of those whose business it is to deal with these matters—at least, not so far as I know.

Before retiring, however, I am begging the courtesy of your columns to say a "last word" upon the subject.

First, may I clear away a misunderstanding which I think exists, viz., that I definitely advocate an alteration in the existing methods of charging for electricity; I do not. I am not competent to presume to offer an opinion upon a matter which is beset with many difficulties of a purely practical character, and in connection with which many safeguards must be resorted to, which may involve the setting aside of otherwise right principles. My criticism is directed entirely and solely against the adoption by nearly the whole of the electrical industry of a principle which I believe to be scientifically unsound. That principle was expressed in Mr. Yerbury's paper on the first page, where he says that the price of any commodity is "determined, firstly, by its entire cost of production, and secondly, by the number or quantity sold."

For reasons that I have given, I believe that that is a scientifically untrue definition. It may be a useful working hypothesis, I don't know, but it is not true, and it is obvious that engineers who set out with false principles are not unlikely to arrive at false conclusions.

To my mind Mr. Yerbury's definition is as erroneous as to

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* *Proceedings* Institution of Electrical Engineers, Vol. 40, Part 188, p. 338, and Vol. 42, Part 193, p. 52.

express Ohm's Law as C = E, because in both cases an essential factor is omitted.

The adoption of my definition of price (which is, of course, not in any way original) would necessarily have the following consequences :—

1. The present definition of the word "equitable" would be abandoned, and the basis of the *market price* of the service rendered would be substituted for the present basis of the relative *cost* of supplying different consumers.

2. As a corollary of the above, it would become necessary to distinguish between supplying light, heat, power, &c., disregarding the fact that electricity supply is common to all three, just as in ordinary commercial life the hours of labour which are common to the creation of value of different kinds are generally disregarded.

3. The recognition that the greatest aggregate gain can be obtained, and its most equitable distribution secured, when every part of supply is sold at its true market price, and that selling according to cost involves the loss of profit to the producer and of profit to the consumer.

4. The coming into line of the electricity supply business with other commercial undertakings such as railways, steamship companies, &c., which apply as far as they can the principle which I believe to be right.

It may be regarded as impracticable to apply a right abstract principle in the electricity supply business so as to gain the advantages enumerated above—that is not my immediate concern, but it is my concern to ask my brother engineers to realise what they and their consumers are losing by selling upon a wrong principle, even though, on account of practical difficulties, they can see no way of avoiding the loss.

Whether wealth is being lost to the community by the error I have called attention to or not, it is impossible to say, but I do feel that there is a great risk of this being the case ; instances have come to my notice of supply being sold at prices which violated the widely established principle which I hold to be a false one, and, nevertheless, the larger aggregate profit has been made, and a larger measure of useful service rendered.

Edw. W. Cowan.

London, E.C., *January 28th*, 1910.

Methods and Practice in the German Electrical Industry.

With reference to the correspondence induced by "Zähler's" letter and the criticism on the subject of home manufactures, I assume that Mr. A. B. Anderson's letter was meant to point out that the 200,000 workmen went abroad to find employment owing to lack of the same here, and that they received less on the Continent than in England, not that those men were desirous of taking a lower wage elsewhere, as Mr. J. Stottner queries. When it becomes a question of half a loaf or no bread, the former becomes acceptable.

As I understand Mr. Anderson's letter, he means that this country is at present the banking centre of the world, and that by proper and careful operation of protective duties we may compel other foreign firms to put down works in this country and increase home employment. Unfortunately, Mr. Anderson does not say what is to become of the increased outputs under the additional competition which must ensue.

Colonial support would, it is to be assumed, be the solution of this difficulty; therefore, had we not better be quite sure of our ground there first? There is an increasing tendency in the Colonies to support the local producer, and this will grow rapidly, so that we may soon expect to see developments in this direction.

No amount of protection can keep out a superior article for which there is a demand, and it is proverbial that many things initiated in Britain are perfected by the foreign firms and ultimately sold against us in our own markets.

To my mind, initiative and enterprise are wanted, with encouragement to the lucky possessor of those qualities, for with them will come Nature's first law of self-defence.

Protection will not bring enterprise, but enterprise will bring Protection at a proper time and of a proper character.

Legal restrictions on trade of a wholesale nature are always more or less a failure; the present position of the Empire is one of growth, and by a process of growth we shall protect our interests, given initiative and enterprise.

I do not think that at one sweep we can protect our markets.

Trade conferences and co-operation of like interests with a firm hand are likely to do more to bring about Government enactments to protect trade where it is wanted. A gradual cover is then built up, and we may become the best protected country in a premier position to control manufacturing and finance.

I would suggest that protectionists look out for their colonial interests as a first step to home tariffs, by establishing houses in the colonies to look after their interests and manufacture there if necessary.

A. W. Greening.

London, *January 28th*, 1910.

The "covert impertinence" which Mr. Bruce Anderson detects in my letter which appeared in your issue of the 7th, is, I venture to say, just as illusory as Mr. Anderson's fiscal arguments. My remarks were made entirely in good faith, and I am sorry that Mr. Anderson should have misconstrued them. As managing director of one of our leading meter manufacturing firms, I am sure anything he has to say on this particular subject must command our respectful attention, and I can only wish that Mr. Anderson had dealt with the subject a little more fully, and if I may say it, without "impertinence," left some of the adjectives and adverbs out.

Mr. Bruce Anderson's two statements were :—

1 "Our unemployed are increasing every day."

2. We are living "to a very large extent upon our income."

Statement (1), if true, can surely be substantiated by figures. All the official figures prove that the statement is wrong. Surely, also, the trade union returns must provide a reliable index figure of the *relative* condition of the labour market from year to year, as the amount of work available for the unskilled labourer must be very nearly proportional to that for the skilled artisan. Mr. Anderson also refers to our "teeming workhouses." If, however, he will consult the Local Government Board statistics he will find that pauperism is not increasing, but decreasing. Pauperism has never been so great as it was in the former half of the last century, under Protection.

Now, as regards the second assertion, I note that Mr. Anderson "accepts my figures," and as he does not make any effort to controvert my argument, I take it that he admits that his statement was inaccurate and that we are not "living to a very large extent upon our income from our foreign investments."

Mr. Anderson asks, "Where is my remedy for unemployment?" I reply that there is not any Aladdin's lamp, such as is propounded by the Socialist and the Tariff Reformer, to rub and cure this evil. It can only be remedied by the development and organisation of the resources of the nation. To imagine that we can do it by juggling with protective tariffs is to deceive ourselves. Mr. Anderson's treatment of the foreign meter trade question illustrates the error into which most Protectionists fall when dealing with this subject. They all argue from the particular to the general, whereas I would maintain that the only true method to discuss a vast subject such as this is to argue from the general to the particular. What is good for the country as a whole must, in the long run, be the best for each constituent trade.

Now, looked at from the general point of view, we find that the total production of manufactured goods in this country exceeds £2,000,000,000 sterling yearly. Our total imports of articles "wholly or partly manufactured" amount to, roughly, 100 millions yearly—*i.e.*, not 5 per cent. of our total manufactures. To maintain that this relatively insignificant importation is ruining British industries is, I think, absurd.

Dealing now particularly with meters, can it be denied that Protective duties upon copper wire, iron stampings, steel magnets, dial counter mechanisms, brass and iron castings, &c., will increase the material cost? Or that a tax upon food will increase the cost of living of the workmen and result in demands for larger wages? The English market will, moreover, not be any more secured to Mr. Anderson than at present, as I do not think he can deny that the effective competition in this country at present is

made by English firms. The net results would be increased costs, and this could only result in Mr. Anderson being in a worse position than at present in endeavouring to export to foreign countries. Cobden's words, often forgotten, were very true—"The best way of dealing with foreign tariffs is free imports."

This is an inexhaustible subject, and I must not venture upon your space any more. In conclusion, I would like to wish Mr. Anderson every success in his laudable efforts to extend our trade and to meet foreign nations on their own ground, only I would beg of him not to cry too much "stinking fish," for, after all, we *are* a great nation of "fighters, producers, manufacturers and distributors," and intend to remain so, even if we don't all agree about the fiscal question.

Zähler.

Birmingham, *January 25th*, 1910.

THE "SILENT" ELECTRIC CLOCK.

In our issue of August 3rd, 1906, we described the system of electric clock mechanism devised by Mr. G. B. Bowell, as it then stood. Since that date great progress has been made. The latest type of electric clock movement made by the Silent Electric Clock Co. (on G. B. Bowell's patents) is so simple and effective that it is well worthy of a further notice. As we have often pointed out, the advantages and economy of operating a plurality of clocks electrically are very considerable, particularly in large buildings. Mr. G. B. Bowell, who since 1895 has devoted much attention to this subject, has long entertained a great antipathy for electric dial-work with ratchet-actuated mechanism, which is apt to be noisy, and is liable to undue wear, and he has developed a system free from this mode of operation.

Fig. 1 shows the Silent Electric Clock Co.'s mechanism for effecting the half-minute advance of the hands of each dial; it consists of a train of gear-wheels terminating in an arbor which

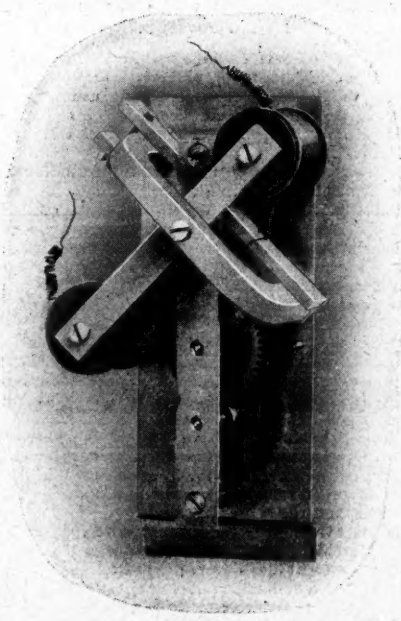
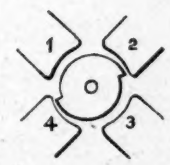


Fig. 1.—Dial Mechanism.

carries a double-cam-shaped armature. This rotates freely inside a circle of four iron pole-pieces, as shown in fig. 2, and is normally held at rest by the provision of a permanent magnet which spans two opposite pole-pieces. The electromagnet spans the intervening pole-pieces, and is energised for a fraction of a second at each half-minute by the line current; when this happens, the cam-shaped armature is drawn forward one quarter turn, and when released by the cessation of the line current, it is drawn forward another quarter turn, and there held by the permanent magnet. The advantages of this arrangement are (1) a completely positive action and immunity from risk of overshooting, since the armature is always in a strong magnetic field, and (2) the total absence of reciprocating mechanical parts, from which is obtained (3) silence in action.

It will be noticed that, thanks to the gearing, the armature's half-turn has only to effect a $\frac{1}{110}$th turn of the arbor which carries the minute hand, and consequently ample power is available at the hands.

Fig. 3 shows the "master" movement, which consists of a pendulum kept swinging by occasional impulses from an electromagnet, the circuit of which is closed when a trailing nib depresses a contact spring. This device, which has appeared in many clock systems since thirty years ago, is very pretty in action, and possesses two important advantages over other methods of driving a pendulum, viz. (1) that the "circular error" (*i.e.*, the difference



1, 3, poles of electromagnet; 2, 4, poles of permanent magnet.

Fig. 2.—Diagram of Driving Mechanism.

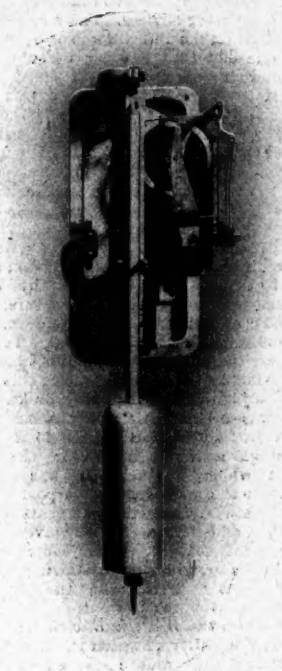


Fig. 3.—Master Movement.

in time required by the pendulum to perform a long or short arc in a circular path—the long and short arc being isochronous only if the path be a cycloid) is practically obviated; and (2) the chance of the pendulum stopping through insufficient impulse is well guarded against.

It is mainly for these reasons that the Silent Electric Clock Co. have adhered to this method of actuating their master, but it should be mentioned also that they have devoted much care to the perfecting of the design and construction of the controlling parts. The contacts for sending the half-minute current to the line are so designed as to permit of working sparklessly either from a battery or from an electric light supply.

The Silent Electric Clock Co. have now equipped new manufacturing premises at 192, Goswell Road, E.C., where, amongst other details of interest, may be noted the extensive use of roller-bearings for line shafting, and the use of small clutches instead of countershafts for driving the various machine tools.

LEGAL.

J. H. Holmes & Co. *v.* Associated Newspapers, Ltd.

This case came before the Court of Appeal, composed of the Master of the Rolls and Lords Justices Moulton and Buckley, on Wednesday, January 26th, upon the plaintiffs' appeal from a judgment of Mr. Justice Neville in the Chancery Division.

The plaintiffs were the patentees and registered legal owners of Letters Patent No. 9,802 of 1898, granted for an invention of "An improved system and means for driving newspaper printing or like machines at variable speeds by electric motors," and plaintiffs alleged that the defendants had infringed the Letters Patent, and claimed an injunction and the usual ancillary relief. Defendants pleaded that plaintiffs' patent was invalid for want of subject matter, and that there had been prior user. Mr. Justice Neville, after hearing a mass of technical evidence, held that the plaintiffs' patent was invalid, and that the plaintiffs' action for infringement failed, and dismissed it with costs. Hence the present appeal of the plaintiffs.

Mr. A. J. Walter, K.C., and Mr. J. H. Gray appeared for the appellants, and Mr. Astbury, K.C., and Mr. D. M. Kerly for the respondents.

Mr. Walter, having stated the nature of the action, and the decision arrived at by Mr. Justice Neville, was asked by Lord Justice Moulton if the question of infringement was seriously fought?

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Mr. Walter replied that it was, and continuing, said that what the patentees' invention had to meet was as follows:—The modern printing press had got starting at one end, sometimes four rolls of paper and a continuous web of about four miles in length. The paper from those rolls which was under tension passed over rollers and ultimately arrived at a metal roller on which the paper rested, whilst another large cylinder carried stereos which impressed their matter on the other side of the paper to that which rested on what was called the blanket. Then the paper passed through another lot of rollers and was printed on the other side. It was afterwards folded and cut by other devices. These rollers weighed some tons. It was necessary that the delicate web of paper should pass over the rollers from one end to the other in an unbroken condition, and with machinery running at a high speed that was a difficult matter. Inventions having for their object the passing of the paper so that it should not be jerked, were many. Having briefly enumerated the old systems of driving, the learned counsel said the time came when the electric motor was brought in for the purpose of driving printing presses. All motors were really bundles of wires rotating between the poles of a magnet. Current passed through the armature, and under the old devices the difficulty was to prevent current rushing in in great quantities, which caused starting with a jerk, and if it did not, they soon had to discuss the question of a burnt armature. That was, to some extent, got over by having external resistances between the switch and the armature. That meant loss, but you got less current through the armature. The first idea was to use the motor simply as prime mover. The next thing was having two armatures on one shaft rotating between the poles on one magnet. The evidence was that when this change took place, the machine jumped and the paper broke. The next arrangement was what was called the "teaser arrangement," which was the use of a motor across the mains to drive the generator, and the latter gave the current for the machine motor. Another system which was devised was having a low-speed motor geared to the press for the purpose of starting it, and then connected with another chain of gearing. There was a high-speed motor, and that was governed by its rheostat, and they wound that high-speed motor so that it should have additional coils to give a large starting torque. Then they had an arrangement by which, when the big motor had got up its speed, the small motor was cut out. That system was introduced by a paper called the *Western Electrician*. Plaintiffs then adopted a system, the utility of which was not challenged, and the evidence was that it did produce marvellously smooth running of printing presses. The learned counsel explained that in the plaintiffs' system two motors were used, a small and a big motor, so connected that while the big motor was getting up speed it was assisted by the small motor. The current of the small motor was kept constant, while the current of the big motor was gradually built up, and the small motor was cut out as soon as the big motor had run up to full power. The overlap and interconnection of the two motors, as the patentee said, was the combined electrical and mechanical system of driving printing presses. The learned counsel then referred at considerable length to the specifications both of the plaintiffs and the alleged anticipations, and the evidence. He contended that Mr. Justice Neville was wrong in holding that Claim 1 of the plaintiffs' specification was for the use of mechanism that had been already publicly described in this country before the date of the plaintiffs' patent. He submitted, therefore, that the appeal should be allowed.

Mr. Gray having followed on the same side, Lord Justice Moulton, who delivered the first judgment, after stating the facts, said that in his opinion, Claims 1 and 2 of the plaintiffs' specification could not be supported. The prior publications had described existing plant in work turning out daily newspapers on a very large scale in Chicago. It was said that there was no direct evidence of their having succeeded. From the articles which had appeared in the *Western Electrician* and the *Electrical Engineer*, he could not doubt that the plant was in work, and worked satisfactorily. He considered that both claims were anticipated by that installation, which was thoroughly described, and therefore the plaintiffs' patent was invalid. That being so, no patent could take away the right of the public to make such an installation. He thought that the decision of the learned Judge in the Court below was right, and that the appeal must be dismissed, with costs.

The Master of the Rolls and Lord Justice Buckley concurred, and the appeal was dismissed accordingly.

Cramp v. Cunnington & Harris, Ltd.

In the Westminster County Court, on Thursday and Friday last week, Mr. Thomas H. Cramp claimed damages from the defendants, a firm of electrical engineers, for wrongful dismissal.

Mr. G. S. Sanders, counsel for the plaintiff, said that he was in the employ of Messrs. Frank Suter & Co., Ltd., and defendants took him over with the business and appointed him secretary at £3 10s. a week and a share of the profits. He was a Fellow of the Chartered Institute of Secretaries, and claimed that he was entitled to a longer notice than the defendants gave him.

Plaintiff gave evidence that he was secretary of Suter & Co., and for a time was a director. The defendants bought the goodwill and assets of Suter & Co. from the Receiver, and Mr. Samuel Harris was appointed secretary when the defendant company was formed in September last. The next month, as the minutes showed, he was appointed at a weekly salary of £3 10s. and 10 per cent. of the profits to be distributed amongst the shareholders. On November 12th he was given a week's notice, and he told Mr. Harris that he could not accept it. Mr. Harris telephoned to his brother, Mr. Alfred Harris, the solicitor to the company, and also a director, and he was offered a cheque for the next week in lieu of notice. He refused it, on the ground that the notice was not long enough for a secretary. He was told that the company could not afford to keep a secretary, and he pointed out that the business was better than when he was appointed.

Cross-examined: The business was purchased from the Receiver for £850. He thought there was a good business, and he told the defendants that he knew all about it, as he had carried it on for the Receiver. He was not employed as an ordinary weekly servant, although he was paid weekly.

For the defence, Mr. Samuel Harris, surveyor and estate agent, said that he purchased Suter's business, and arranged with the plaintiff, who said that he could bring a lot of business of Suter's—£5,000 to £6,000—to employ him, and he was engaged as a weekly servant for Cunnington & Harris, Ltd., North Audley Street. In this and his surveyor's business and in his household everyone he engaged was under the terms of a weekly servant. Plaintiff did not bring business, and he also complained to him about coming late to his duties.

Cross-examined: The sole reason for his engagement was that he should bring business, and it was arranged that he could do the secretarial duties.

Re-examined: Witness put over £1,000 into the business to try and make it pay. The secretarial duties would not mean more than an hour's work a day.

Joseph Cunnington, electrician, said that his business was in St. Martin's Lane, and he entered into partnership with Mr. Harris. He was present when the plaintiff was engaged at £3 10s. a week. The offices of the company were at Mr. Harris's, and the works at Hanway Street, Oxford Street.

Alfred Harris, solicitor, and director of the defendant company, gave evidence that the plaintiff said not a word to him as to why he refused a cheque for a week's salary in lieu of notice, merely saying that he wanted a written notice.

His Honour, having heard Mr. R. J. Drake, counsel for the defence, and other evidence, found for the plaintiff, and stated that he had to find what was a reasonable notice in this case, and, having regard to all the circumstances, he awarded the plaintiff two months' salary.

Judgment was entered for the plaintiff for £30 6s. 8d., with costs.

Proctor v. Frontino and Bolivia (South American) Gold Mining Co., Ltd.

In the Lord Mayor's Court on January 27th, before the Common Serjeant (Sir F. Bosanquet, K.C.), plaintiff, Harry Proctor, an electrical engineer, of 27, Clement's Lane, E.C., sued the defendants, of 112, Gresham House, Old Broad Street, E.C., for £245, money retained, and salary and expenses, or in the alternative, damages for wrongful dismissal.

Mr. Harney was counsel for the plaintiff, while the defendant company was represented by Mr. H. Gregory.

For the plaintiff it was stated that he got into communication with the defendants by means of an advertisement, and entered into an agreement to go out to their gold mines in South America. One clause of the agreement stipulated that the directors of the defendant company should retain three months' salary as a deposit in order to guarantee the due fulfilment of the agreement, the money to be later repaid to the plaintiff. The company were also to pay the plaintiff's passage out to South America, and advanced £24 prior to embarkation. The agreement was to take effect from the date of the plaintiff's landing. The defendant company had the power to dissolve the agreement by giving three months' notice in writing, and to pay the plaintiff's passage home. Another clause of the agreement stipulated that if the plaintiff should neglect to conform to any of the articles of the agreement, or misconducted himself, he would be liable to be summarily dismissed, and immediately upon such dismissal he would forfeit all benefits, arrears of wages, and the guarantee fund.

In giving his evidence, the Plaintiff said that he arrived at Columbia on March 16th, 1907. He had to travel as best he could for some seven or eight days from the coast up to the defendants' reef gold mine. When he arrived at the mine he found a Mr. Esson in charge of the mechanical and electrical department. The plaintiff took charge of this department, Mr. Esson returning home. Subsequently the plaintiff wrote to the defendants' superintendent asking for an increase of pay. This was not forthcoming, but he was informed that every six months he would receive a bonus of £24. In January of last year the directors of the company sent out another engineer, and later the plaintiff was informed by the superintendent that this gentleman would be placed in charge of the department which the plaintiff had previously managed. The plaintiff said he could not accept a secondary position, considering that he had been in charge of the department for two years. He was then told that unless he could reconsider the matter the defendants would have no option but to discharge him under the agreement. He was, therefore, dismissed.

At the close of the plaintiff's case, it was submitted on behalf of the defendants that they had no case to answer. The plaintiff had been employed to go out to the mines in Columbia under an agreement. Nothing had been done by the defendants which justified the plaintiff in refusing to work under his agreement. There was nothing in the terms of the plaintiff's employment which prohibited him having an engineer appointed over him. In June of last year

the plaintiff was asked to work under supervision, and he was not entitled to say that he would not do so. Upon his refusal, the defendants were justified in dismissing him. Although the deposit of the plaintiff's had been offered to him, the defendants were entitled to keep it, as the plaintiff, by refusing to conform with the articles of the agreement, had been guilty of misconduct.

The Judge said he thought the plaintiff was entitled to recover his deposit of £36, but no more. It was not unreasonable of the defendants to ask the plaintiff to work under the engineer they had sent out. There would be judgment for the plaintiff, as a verdict of a jury, for £36 and costs.

Eccles Corporation *v.* South Lancashire Tramways Co.

Mr. Justice Eve, in the Chancery Division on Friday, January 28th, delivered a considered judgment in the action, tried last term, in which a declaration was sought that the Salford Corporation were not entitled to authorise the defendant company to use a small section of the Eccles Corporation's electric line. The plaintiffs also asked for an injunction to restrain the tramways company from running cars over the line in question.

The Salford Corporation, who were lessees of the Eccles line, were added as defendants.

His Lordship said it was alleged by the plaintiffs that the granting of the licence was a breach of an agreement entered into in April, 1902, and was, therefore, an act *ultra vires*. On the other hand, the defendants maintained that there was no breach of agreement, and that the transaction was one entirely within the statutory powers of the defendant Corporation. Dealing with the latter point first, he said it resolved itself into the question whether the Corporation as lessees of the plaintiffs' tramways could, in the absence of any special terms in the lease prohibiting them from so doing, grant to the defendants permission or licence to use the tramways or any part of them. The plaintiffs said No, that the subject matter of the demise was a Parliamentary franchise — the statutory monopoly to use on the authorised tramway carriages with flanged wheels or other wheels suitable only to run thereon—and that it was for those who asserted the power as lessees of such a subject matter to license others to use the tramways to demonstrate clearly where such power was to be found. They further pointed to Sec. 35 of the Tramways Act of 1870 as indicating the only circumstances in which the Legislature had contemplated the joint user of a tramway by licensees and promoters or the lessees of promoters. The defendants did not dispute that the burden of establishing statutory authority was upon them, and they contended that, so far as the Corporation was concerned, the authority was to be found in the Salford Corporation Act of 1899, and so far as their licensees were concerned, power to accept the licence was conferred upon them by the South Lancashire Tramways Act of 1903. The Act of 1899, read in the light of the facts of the case, empowered the defendant Corporation to enter into and carry into effect contracts and agreements with the owner of any tramways in any adjacent districts which could be worked with the tramways demised to the Corporation by the plaintiffs. In construing the Act he was bound to treat the defendant company as the owners of the tramway in an adjacent district, having regard to the object of the section and to the fact that the expression "Corporation tramways" included tramways demised to the Corporation. The contracts and agreements contemplated by the section were contracts with respect to the working and use by the contracting parties of all or any of their respective tramways and works, or any part or parts thereof respectively, to the supply for all or any of the tramways of the contracting parties being worked by the other of them, of rolling stock, plant and electrical energy and to other matters therein mentioned, which included the "interchange, accommodation, conveyance, transmission and delivery of traffic coming from or destined for the respective undertakings of the contracting parties." For what purpose and with what object was such a section introduced into this and other Acts? Could anyone doubt that the main objects were to obviate the multiplicity of administrative bodies and to concentrate so far as possible the management and control of the several undertakings in the hands of a few authorities, thereby lessening expenditure and cost of transit and avoiding possible interruptions to through traffic and facilitating intercommunication between the undertakings? In short, it conferred in very wide terms, powers which enabled the undertakings of the various promoters to be worked in the manner best calculated to meet the public convenience and to secure traffic as one continuous undertaking and not as a series of disjointed undertakings, each managed, worked and controlled by a separate authority with no power outside the limits of its administrative area. In his opinion, the terms of the section were sufficiently wide to confer upon the defendant corporation authority to make the arrangement which was embodied in the licence of June, 1908, and the mere fact that the arrangement assumed the form of a revokable licence was not material. So long as the licence remained in force, and the licensees took the benefit of it, they were under contractual liability to pay the mileage charges thereby established, and he thought he would be adopting a too narrow construction were he to decide that the arrangement brought about by the document was not within the scope of the section. For similar reasons he thought the terms of Sec 41 of the South Lancashire Tramways Act, 1903, authorised the arrangement on the part of the defendant company. He came, therefore, to the conclusion that the plaintiffs could not succeed on the ground that the impeached transaction was one *ultra vires* of the defendants or either of them. The question remained whether its vitality could be successfully assailed on the ground that it was a breach of the agreement on April 11th, 1902. The plaintiffs contended that the whole agreement was so framed as to impose on the defendant corporation the obligation to work the demised tramways themselves, and to exclude a construction which would confer upon them any right to transfer the obligation. The defendants, on the other hand, pointed to the schedule as negativing the argument founded on any inherent non-assignability of the contract. He thought the contention of the defendants ought to prevail. The expressed intention of the parties was, except as therein provided, the defendant corporation were to have assured to them the plaintiffs' statutory rights to the exclusive use of the tramways; that was to say, that as between the contracting parties the defendant corporation was to step into the place of the plaintiff corporation, except so far as the contract otherwise provided. In the absence of any express stipulation controlling the free exercise by the defendant corporation of the statutory power of granting the licence, which he held them to possess, he did not think he ought to imply or infer any such restrictive stipulation merely because an examination of the agreement left upon one's mind the impression that the parties entered into it contemplating that the tramways would, in fact, be worked by the defendant corporation, and that neither of them at the time appreciated that an arrangement such as had been come to between the defendants was practicable, and, if come to, would not be contrary to any expressed terms of the agreement. He held, therefore, that there had been no breach of the agreement by the defendant corporation, and dismissed the action with costs.

Cownie *v.* Cobay.

Mr. Justice Ridley, sitting with a special jury in the King's Bench Division on Monday, heard an action for alleged slander brought by Mr. William Brodie Cownie, the general manager and secretary of the National Electric Construction Co., of Westminster, against Mr. Robert Cobay, a Hythe surveyor.

Mr. Eldon Bankes, K.C., with Mr. Marriot was for the plaintiff, while the defendant was represented by Mr. Shearman, K.C., and Mr. Stuart Bevan.

Mr. Marriot said the defence was that the words complained of were fair comment, made without malice on a privileged occasion.

Mr. Eldon Bankes, K.C., then opened the case for the plaintiff, and stated that the slander complained of was a very serious one, having regard to the plaintiff's position. He would have to go back to the year 1905 in order that they might hear the whole story. In that year the National Electric Construction Co., who carried out considerable installations of electric tramways throughout the kingdom, came to the conclusion that they might successfully link up Folkestone, Sandgate and Hythe by means of an electric tramway, and for that purpose a Bill was framed for presentation to Parliament. Mr. Cownie was responsible for carrying out the negotiations, and for that reason it was necessary that he should be regarded as a man of absolute integrity and honour. It would be in reference to an attack on that gentleman's integrity that they would have to deal. Communication took place with the Hythe Corporation and proposals were made with regard to the kind of system to be installed. The chief were the overhead and surface contact (Dolter) systems. Mr. Cownie supported the Dolter system, and eventually the Act of Parliament was passed which gave the Electric Co. the power to construct the tramways. Of course the company were not bound to go on with the work, although there was a clause under which if they failed to do so they were to pay the Corporation a penalty of £1,000. Time went on, and during the next year the company came to the conclusion that the Dolter system would not be satisfactory if it was installed, for similar systems in Mexborough, Swindon and Torquay had by no means proved to come up to expectations; so much so, that the Board of Trade objected to it. The reason for this was that the studs in the road from which the car obtained its current would not act, remaining at the surface instead of falling after the car had passed. Horses were killed, and grave complaints were received. In 1908 the company found that it was absolutely impossible to carry out that system in Hythe, nor were they sure that they would be able to raise the necessary money for the scheme, having regard to the state of the money market. He might add that prohibitive sums were asked for several properties which the company required in the town. In July, 1908, Mr. Cownie again entered into communication with the Corporation, with reference to an alternative scheme. Mr. Cobay was a surveyor in Hythe, who had been employed by Mr. Cownie's company to do certain work, and he sent in a bill for £474 1s. 6d. This bill Mr. Cownie decided was excessive, and he gave instructions that Mr. Cobay should be informed of that fact. That, said counsel, had little to do with the alleged slander, except that perhaps Mr. Cownie's objection angered Mr. Cobay. However, Mr. Cobay accepted £200 in settlement, apparently thinking at that time that he would get more work from the company. In July, 1908, Mr. Cownie was present at a committee meeting of the members of the Hythe Corporation, at which he spoke of the unsuccessful character of the Dolter system, and the result was that a change of system was agreed to, although they did not decide what other to have, coming to the conclusion that a ratepayers' meeting should be held. Then, for some unknown reason, Mr. Cobay took up a violent attitude against a change of system. Of course, he was entitled to do that, but he had no right to attack Mr. Cownie. A poll of the ratepayers was taken, and by a majority of 44 an alternative system was agreed to. Yet the Corporation would not accept the opinion of their committee or the ratepayers, and there the matter stood for a time. Later, another committee confirmed the alternative

scheme, which employed the overhead trolley. Mr. Cownie, very naturally, knowing that Mr. Cobay was against his scheme, employed another surveyor, and they would have to consider whether that action had not something to do with Mr. Cobay's ultimate expression respecting the plaintiff. The Corporation eventually decided again to take the opinion of the ratepayers, and another public meeting was summoned. At that meeting Mr. Cobay took the opportunity of making a personal attack upon Mr. Cownie. In substance Mr. Cobay said Mr. Cownie was a person who was absolutely untruthful and unreliable, and also that he "got at" certain members of the Council to try to induce them to take a certain course. Counsel added that there was a difference of opinion as to the words "got at," the local newspapers only having published the word "got" certain members, but he would call evidence to show that the words used were "got at." Those charges, said counsel, were the most serious a man could possibly make against Mr. Cownie, having regard to his position, for it was, above all things, necessary that people should have faith in his word. No apology had been made by the defendant.

Mr. Cownie, in the witness box, said he was one of the directors of the Folkestone, Sandgate and Hythe Tramway Co. Questioned as to the cost of the various systems, witness stated that the overhead system cost anything from £7,000 to £9,000 per mile, the Dolter about £8,000 a mile and the conduit from £14,000 to £17,000 per mile. In London he believed the conduit cost £18,000 per mile. It was absolutely prohibitive to use the conduit system in Hythe; it was far too expensive. They spent very large sums in Mexborough, but they had a guarantee from the Dolter Co. with regard to the efficiency of the system.

Mr. Eldon Bankes: At that time your company were satisfied with the installation of the Dolter system?—Witness: For the first two or three months we were satisfied, for although there were defects we thought we might remedy them. A deputation from the Councils of Folkestone, Sandgate and Hythe journeyed to Mexborough and viewed the system, being perfectly pleased with it. Later, however, we found that the Dolter system was not a success, the live studs remaining at the surface instead of falling after the car had passed. We had to replace the system at Mexborough with an overhead installation.

His Lordship observed that it seemed to him that they were being asked to inquire into whether the overhead or the surface-contact system should be put down in Hythe instead of whether there had been a slander uttered.

Mr. Bankes explained that Mr. Cownie's honour was attacked with reference to the Dolter scheme, it being suggested that he made untrue statements with regard to the Mexborough and Torquay systems.

His Lordship said he did not think Mr. Cownie could be said to be untruthful.

Mr. Stuart Bevan: It was an expression of opinion on Mr. Cobay's part.

His Lordship: What does this mean, unless it means that the man is a liar? Is a man to be called untruthful because his opinion as to tramways was not the correct one?

Mr. Bevan: The question is whether he could carry out what he said he would. (To Mr. Cownie) There are other systems?

Plaintiff: Yes, what about London?

There is the G.B.?—Mr. Eldon Bankes: Yes, but it died a natural death.

Mr. Bevan: You havn't been required by the Board of Trade to take up the Dolter system in Torquay?—The Board of Trade have written saying that if there is no substantial improvement in the working of the system by April next, they will call upon us to remove the section within the next six months.

Counsel: You were not required to remove the Mexborough system?—No, but we knew what the Board of Trade required, and took the bull by the horns, and removed the system. Mr. Cownie added that his company had raised a million pounds sterling for tramway undertakings. They had spent £50,000 on the "Dolter" system, having made exhaustive inquiries into its working. It was a mistake on their part to have had anything to do with it.

On behalf of the defendant, Mr. Shearman argued that the action was an oppressive one, without any foundation. His client did not attribute any dishonesty to Mr. Cownie, who was a strictly business man looking for dividends for his company. Mr. Cobay thought that the company's conduct was such that it could not be regarded as reliable, while he added that the plaintiff was untruthful, having regard to his actions and statements. This was said in the heat of a controversy.

On Tuesday, Mr. Eldon Bankes informed the Court that he was glad to say that the action had been settled. The defendant had agreed to pay Mr. Cownie £100 in addition to his taxed costs, and expressed his great regret at using any words capable of conveying any imputation upon plaintiff's integrity, and he withdrew such words. The plaintiff admitted that Mr. Cobay's opposition to the altered scheme of tramways was *bona fide*.

Electric Patents Dispute.

In the Chancery Division, on the 26th ult., Mr. Justice Parker had before him the action of Donnersmarckhütte Oberschlesische Eisen-und-Kohlenwerke Actien Gesellschaft *v.* The Electric Construction Co., Ltd. There was also on the list for hearing a petition *in re* The Patent and Designs Act, 1907, and in the matter of the application of James Gray, of Letters Patent Nos. 7,188, of 1902, and 13,556, of 1902. The application by James Gray was an application under Sec. 27 of the Patent and Designs Act, 1907, for the revocation of the Letters Patent No. 7,188, which were granted in 1902 to Carl Ilgner, and were for an improvement in the means for the control of electrically-driven reversible rolling mills, and of the Letters Patent No. 13,556, also granted in 1902 to the same person for an improvement in the means for the control of the supply of electricity to electric motors for hauling plant and similar appliances in which the demand for energy was intermittent. The applicant was Mr. James Gray, of Dashwood House, New Broad Street, and managing director of the Electric Construction Co., Ltd., and the matter came before the Court by way of appeal from the Comptroller-General of Patents, who, by an order dated July 2nd, 1909, refused to call upon the patentee of the Letters Patent in question to deliver further and better particulars of the matters set out in a declaration of one Francis Herd, whose declaration purported to set out the value of the plant made in this country under the Letters Patent and also the value of the plant imported under the Letters Patent. The action was brought by the Donnersmarckhütte Co. against the Electric Construction Co., and the claim was for an injunction to restrain the defendants, their servants and agents from selling, offering for sale, or in any way dealing with any apparatus made in infringement of the plaintiffs' patents No. 7,188, of 1902, damages, or an account of profits, and delivery up for destruction of all apparatus in the defendants' possession construct in infringement of the Letters Patent.

Mr. Walter, K.C., Mr. Gray and Mr. Hume appeared for the plaintiffs in the action, and Mr. Bousfield, K.C., and Mr. Russell Clarke for the Electric Construction Co.

In opening the action, which was proceeded with first, Mr. Walter said that, before coming to the specification, he should have to put his Lordship in possession of certain data relating to the machines in connection with which the invention was used and the electrical contrivances that were available at the date of the patent. They had to deal with one of the most difficult machines which was to be found in mechanical engineering work, namely, a reversible rolling mill. This required great power, sometimes as much as 12,500 H.P. being used. The only way the thing was done was with a steam engine and boiler of sufficient capacity to pull the load through. Great control of the engine was necessary, and for a long time that was a stumbling block in the way of electrical engineers. The specification in question was for an electrical arrangement which would enable electricity to be commercially applied to reversible rolling mills. The patentee had done what no other had done, and that was to apply electricity to reversible rolling mills, and do it economically. Mr. Walter then proceeded to explain the methods of employing elecrical power to his Lordship.

On Thursday, Mr. Walter said that one of the well-known systems of rheostatic control was invented by Ward-Leonard. What he wanted to do was with a varying load on the motor to keep the demand on the source of supply constant. To do this he introduced a primary motor and another generator. He put resistances into the field of his generator and thereby lowered the voltage of the current, juggling with volts and amperes so as to maintain the call upon the source constant. But the process was useless for any such appliances as reversible rolling mills. About the beginning of 1902 Mr. Ilgner conceived the possibility of so varying the Ward-Leonard system as to solve the problem. The first thing that he had to do was to differ *in toto* from Ward-Leonard in not having a constant-speed motor as his primary motor. Ward-Leonard had not realised that it was not necessary to have the primary motor and the working motor equal in power. For the patentee's purpose it was necessary to have a working motor that was big enough to drive the rolling mills and take the maximum load. The patentee thought that if he had a primary motor whose speed would fall off as the load increased, and if he had a connection between and upon the same shaft as the primary motor, the generating armature, and a heavy fly-wheel, he could take up the energy so that when the load came on the working motor, and it tended to slow up, so would his primary motor and then the stored-up energy in his heavy fly-wheel would supply the power needed to do the work in the working motor. The stored energy was brought into play because the primary motor was a motor whose speed diminished as the load increased. For starting or varying the speed, the Ward-Leonard system of control was used. All that was required was a motor whose speed would fall off as the load increased, so that the big fly-wheel would be no longer driven, but itself became a driver. The energy stored in the fly-wheel would supply the electric current necessary for the working motor. In order to reverse the working motor he simply reversed the flow from the generator, which was done by an ordinary reversing switch. If starting was the only thing necessary, a series-wound motor would be the best, but the patentee wanted to brake as well as start. If they had a pressure-wound working motor, and a pressure-wound generating motor, the effect of the reversal of the current was that they mutually braked one another. The working motor acted as a generator, and that tended to pull it up, so that when the energy stored in the moving parts was being arrested, it was assisted by the working motor acting as a generator. Such an improvement was caused by the use of electrical energy in place of the old steam engine that the reversal could now be made so as to do six passes a minute. Without the ingot, the whole of this enormous machinery had been reversed eleven times in a minute. As a matter of fact, they could actually stop the rolls and reverse them 30 times in a minute if the billet was not being passed through. It was a curious thing that the defendants, who were saying that this was Ward-Leonard, and nothing but Ward-Leonard, had not produced a single instance of the thing being done prior to 1892.

In the year 1892 it was known that they could not regulate by introducing resistances into the shunt, because if they did they would stop the machine altogether. Yet it was suggested by the defendants that according to the specification they had not to use the only system that with shunt winding enabled them to introduce resistances into the field of the dynamo. No electrician reading the specification would think any such thing.

Thursday and Friday were occupied by the plaintiffs' evidence. Mr. Swinburne described the working of a reversible rolling mill. The system he described he said had great disadvantages, but up to the date of the plaintiffs' specification it was the only one used. There was no other way to do it. He had never heard of electricity being used for driving the rolls prior to the date of the patent. What the Ward-Leonard system did was to get rid of the waste in the resistances in the main circuits, but otherwise the load on the mills was the same as the load on the main. Ilgner took away Ward-Leonard's primary motor and put in a smaller one, which was so designed that if the load increased it ran slower. He then added a fly-wheel, and by that means got a machine which would give 12,000 h.p. for a short time without taking more than at the rate of 3,000 h.p. from the mains. The other 9,000 h.p. was temporarily supplied by the fly-wheel. He had read Ilgner and found no difficulty in finding what he had described. It was a special device to deal with the special problem of rolling mills. With regard to the objection that no means was described of regulating the current demand of the motor-generator, he thought it was quite clear from the specification that they must have a resistance in series with the field of the generator, and that they had a primary motor so designed as to run slower as the load increased. Everybody would know how to arrange it when once they got the idea. He, as an electrician, found no difficulty at all.

Witness then proceeded to explain in detail the difference between shunt and series winding, and the difficulty of using a series machine as a brake. He thought it quite likely that they could use the plant perfectly by using a shunt machine with resistances. He, as an electrician, however, would understand separate excitation. It was clear to him that Ilgner's was an economical method of applying electricity to rolling mills. Witness then proceeded to explain a drawing of the plant supplied by the defendants to Sir Alfred Hickman. In his opinion, he said, the arrangements were just the same as were found in Ilgner's specification.

Cross-examined, Witness said he did not know that the very first electrical system that was built in England was the one complained about in this action. Witness did not think that before Ilgner's patent a designer had all the material that he would want. Fly-wheels had, of course, been used in all sorts of ways before. They had the braking action in the Ward-Leonard system, provided a shunt machine was used for the motor. In Ward-Leonard they had everything that Ilgner told them, with the exception of the fly-wheel, which was to give out energy by slowing down.

Mr. Bousfield referred to the Electrical Review of January, 1897, which, he said, gave a very good description. Again, in the Electrical Review of 1900, there was a description of the Ward-Leonard system applied to something else.

Mr. Walter said it was not the Ward-Leonard at all. A number of specifications were put to Witness, but he said he found in none of them the Ilgner idea of coupling the two electric motors with a fly-wheel.

Mr. C. A. Ablett, examined by Mr. Hunter Gray, said that he was a civil engineer, and was employed by Messrs. Siemens Bros. Dynamo Works, Ltd. He had charge of the rolling mills and the central station and power department. He had extensive knowledge of the rolling mills operating in England. He had never seen rolling mills electrically driven by any other system than the Ilgner. He knew of no other in existence. There were three mills at work in England on the Ilgner system, and he had seen all of them. They were not all satisfactory. He had seen one where the reversal was very slow, and where there were considerable fluctuations in the demand on the power house. That was on account of faulty design. With a steam engine the power had to be in the hands of a skilful man. With the Ilgner system that was not the case. In one plant that had been running for over a year a very considerable saving had been effected by the Ilgner system, amounting to about 1s. 3d. per ton rolled. He had seen the plant at Sir Alfred Hickman's works. He saw the billets being rolled. The moving-coil regulator was, however, not at work.

Cross-examined: When he was there both rolls were working, but not working simultaneously. Some of the Ilgner plants had regulators.

On Monday Mr. Bousfield, opening the case for the defence, submitted that whereas in the idea of putting a fly-wheel in the Ward-Leonard system, or working a Ferranti motor transformer with a fly-wheel, there was no invention; still, in the defendants' view, there would have been invention in finding out the best way of putting the two together. The whole invention consisted in putting two ideas together, and there was no invention required in carrying it out. Ilgner did not attempt to tell them more than the bare idea of putting the two motors together. Mr. Swinburne had suggested something as being obvious that was less obvious than the method he (counsel) suggested. In order to get sufficient speed drop they put a series-winding in combination with a shunt-winding. That appeared less obvious than the other two things that Mr. Swinburne thought were not obvious at all. Where they did not introduce resistances they varied the current they were sending out to the motor. The essential idea of the defendants' invention was that it gave them a varying field for the primary motor. That was not invented by Ilgner. They did increase the E.M.F. in the primary motor, but it had quite a different effect to a series winding. This was essentially a matter for practical electrical engineers. Their evidence would have been of great importance, and yet the plaintiffs had not called any. He proposed to call a number of witnesses who were actually engaged in solving this problem.

(To be continued.)

Gravesend and Northfleet Electric Tramways *v.* Mayor and Corporation of Gravesend.

On Thursday, January 27th, Mr. Justice Hamilton, sitting in the King's Bench Division, resumed the action against the Gravesend Corporation, in which the Gravesend and Northfleet Electric Tramways, Ltd., sought a declaration that they were not bound by the reading of certain electric meters on the Corporation premises by which they were charged for the electric energy to work their line. They also asked for an injunction restraining the further use of the meters objected to, and also for damages.

The plaintiffs were represented by Mr. A. J. Walter, K.C., with whom was Mr. E. Hills, and for the defence Mr. W. R. Bousfield, K.C., and Mr. G. A. Scott appeared.

Mr. Percy Newton Grey, secretary to the plaintiff company, was called, and in examination by Mr. Hills, said that he had got out a table showing the consumption of units per car-mile from 1902 to 1909, and it showed an increasing consumption. The consumption in the year 1909 got up to 1·426 units.

Mr. Hills: What is the amount you pay to the Corporation for electrical energy per annum?

Witness: About £3,250—that is the amount as claimed.

Mr. Hills: Assuming for a moment that the tests prove an excess of current, the claim is about £500 or £600 more than the actual consumption?—I estimate it at about £525 per annum.

Mr. Henry Sayers, consulting electrical engineer, said he prepared the table put in evidence at the previous hearing, in which the units per car-mile from 1905 to 1909 were set out. That showed that for 1905-6 and 7, the average units per-car mile fell a little year by year. In 1905 the units were 1·216, in 1906 they were 1·199, and in 1907 they were 1·198. In 1908 the average rose to 1·382, and in 1909 it rose to 1·416. He had also got out a table showing the passengers and the units per car-mile for the same years. The car-miles had gone down in each year—from 358,000 in 1905 to nearly 305,000 in 1909. In working out the passengers per car-mile and the units per car-mile he could see no connection between the two. When he inspected the meters at Gravesend he found three meters fixed to one end of the switchboard very low down and a few inches only above the platform flooring. On going behind the switchboard he found immediately under the flooring or platform, and, therefore, within a few inches of the meters, a great body of cables carrying current out into the streets. Some of the cables were carrying the tramway current, but he did not think all of them were.

Would the proximity of the cables affect the meters?—Undoubtedly. The current passing through them would produce magnetic fields which might affect the meters to a greater or lesser extent. He found by actual trials with a pocket compass that there were considerable fields due to the cables round the meters. The effect would be to make the meters fast and tend to increase the record not equally in all the three meters. Do these meters, as they are fixed, measure the amount of current actually supplied by the Corporation to the company?—I do not think they are reliable for that purpose. In the September and October tests the average excess shown by the B.T.-H. meters over the Aron was about 23·6 per cent., and the B.T.-H. meters varied amongst themselves.

Cross-examined: The steady increase he attributed to the fault in the meters, and his opinion was that in 1908 and 1909 the meters had overcharged. The B.T.-H. meters were very largely used for measuring tramway loads. He had put in more B.T.-H. meters for tramway purposes than any other. What he complained of in this case was that the surroundings were not fitted for that particular type of meter.

In re-examination, Witness said that the Aron, as a measuring instrument, was more accurate than the B.T.-H., and, being more accurate throughout its whole range, it did not favour either the consumer or the supply. The Aron measured small loads with great accuracy. He had measured loads of one ampere with a 300-ampere meter. He had had a current on for 24 hours, and the Aron record was 12½ units. That experiment was made at Willesden in the test-room of a power house. He did not know of any meter which gave such a straight line as the Aron. At Gravesend there were 15 or 20 cables passing under the switchboard near enough to affect the meters.

This was the plaintiffs' case.

Mr. Scott submitted that no case had been made out for him to answer. The only basis of fact upon which the agreement could be upset was that the meters were not meters within the meaning of the agreement. It was pleaded that, to the knowledge of both parties, the meter was not a meter within the agreement, but the case proved was simply that a certain class of people looked with more favour on one meter than on another.

His Lordship said he understood the plaintiffs to say that under the agreement the defendants must maintain a meter that would meter, and that the meters used had such a large percentage of error as to disqualify them. There was, therefore, a case to answer.

Mr. Scott said that, in those circumstances, in the absence of his leader (Mr. Bousfield), he would at once call witnesses.

Mr. Henry Hampton Brown, the town clerk of Gravesend, said that in 1907 the plaintiffs made a claim for a reduction of their

electricity bill. The claim was for £148 10s. He consulted the Corporation engineer, and found that he had been taking the readings of the meters in a wrong way under Clause 4 of the old agreement. Negotiations took place, and the company accepted £75 in settlement.

Cross-examined: During the negotiations the question of the supplemental agreement was raised because they said they wanted a different method of supply, but that was not the reason why the company accepted less than they were claiming. On the following day (Friday), Mr. John Rennie was called, and said that he had charge of the Electrical Standard Laboratory of the Board of Trade, and was acquainted with the tests which the Board made, and had given certificates in relation thereto. He produced certificates of tests made in 1907 and 1909 of meters, at the request of the Gravesend Corporation. The Board of Trade did not readjust meters.

Mr. Chas. Fredk. McInnes, electrical engineer to the defendant Corporation, said that he had held that appointment since 1902, which was the year when the supply of electricity began. The three meters had been in since that date, and had measured the supply to the tramway company. There had been no alteration at all in the meters. In the first instance, the supply was measured at the point of delivery, up to the date of the supplemental agreement when an alteration was made by which the measurement was taken at the switchboard itself. The actual alteration in the connection was made on February 5th, 1908. The meters were on the switchboard before that, but they previously measured a current brought back from the point of supply. There was a clause in the agreement which gave a calculated allowance for the loss. The meter readings were entered up in log sheets and added together at the end of the week. As a rule some one came down from the Tramway Co. to see the actual reading of the meters. It was obvious for any one to see what the arrangement was at the switchboard, and it had been carefully examined on several occasions by gentlemen connected with the Tramway Co. The first he heard of the meters being liable to be acted upon by stray fields was after the litigation commenced. Mr. McDonnald had examined the whole of the power house arrangements with him. The vertical cable referred to as likely to create a magnetic field was the cable used for the tramway. The lighting cable was about 4 ft. 6 in. away from the meters, and he, as a practical man, would say that they would have no effect whatever upon the meters. The electric lighting cables were negative and positive cables balanced, and the field from the one would neutralise any field from the other. Those cables were placed in position at the end of 1906, therefore so far as the field would affect the meters the same fields must have been in operation during 1907. He thought the working of the brake accounted practically for the whole of the errors of the meters; but to some small extent it might be due to their running on the shunt. The periodical adjustment of the meters would get over the irregularity, but that was not done by the Board of Trade or the London County Council. The custom was for the makers to do it, and then send it to the Board of Trade for the purpose of being tested. In 1908 the three meters were twice adjusted.

Mr. Frank Holden, electrical engineer, formerly with the B.T.-H. Co., said that he had had wide experience in meter construction. He did not think there was any meter which could be relied upon for any considerable length of time without readjustment. Meters of the B.T.-H. type had in the past been most largely used. All meters must be affected by magnetic influences.

The hearing was adjourned until Monday.

On Monday Mr. J. K. Halden, formerly in the employ of the B.T.-H. Co. as meter tester, and now employed by the Croydon Town Council in a similar capacity, in examination by Mr. Scott, stated that he went to Gravesend on April 15th, 1908, and tested three meters and found that they were reading slow. After examination he adjusted them to read within 2½ per cent., leaving them in thorough working order. He inspected them again a few days later, and found they were working perfectly, reading within 2½ per cent.

Mr. W. A. Dacey, electrical engineer, engaged with the B.T.-H. Co., said that his principal business for the past 10 years had been testing meters. He made a test of the three meters in March, 1907, and found that one read slow and the two others fast. He advised the Corporation to put shields upon the meters with the object of shielding them from stray fields. In 1908 he examined No. 1 meter and found that it required readjusting. He remedied the defects. The B.T.-H. meters were specially adapted to measuring tramway loads, and they were quite capable of readjustment. If the meters were recalibrated half-yearly or quarterly, they would be good meters.

This completed the evidence for the defence.

Mr. Scott, addressing the Court for the defence, said that the origin of the difficulty was that the meters were sent to the Board of Trade instead of to some standardising authority. He was not in a position to dispute that there had been a certain increase in the Corporation's charge for electricity; but as the engineers entertained different views as to the cause, they declined to put in new meters. If, however, the plaintiffs were satisfied that the meters in use were not proper meters, they might take the option of putting in new ones at their own expense. Under the agreement rebates on account of excesses could only be claimed from time to time as excesses were discovered by recalibration, but the plaintiff company, instead of having the meters adjusted at once, said that the fact of the errors *per se* condemned the meters as meters that could not be relied upon, and claimed that the Corporation, under the agreement, were bound to remove them. He submitted that while the burden of proof was upon the plaintiffs, they had absolutely failed to establish a legal right to call upon the defendants to take out the three meters in use and put in three others. Unless they could show that the meters had absolutely ceased to comply with the convention they could not order the defendants to remove them, and therefore their case must fail.

Mr. Hills contended, for the plaintiffs, that the meters were unreliable, and not capable of doing their work, and that they were therefore not merchantable instruments. There were other defects in the meters than those which recalibration could remedy. They had never complained of the type of meters in use, but of the large amount of excess which they registered and of their inconstancy.

His Lordship, in giving judgment, said that no serious dispute seemed to have arisen until 1907, and it was therefore quite clear that the meters and the mode of installation were approved by all parties. In the beginning of 1908 a dispute arose and a supplemental agreement was entered into. It was clear that under the agreement all parties were satisfied that the existing meters should continue to be used, and it was not then contemplated or claimed that others should be used. The dispute afterwards became serious, and the Tramway Co. claimed £253 15s. 4d. for overcharge, and that amount they deducted from the account. That was now the subject of a counterclaim by the Corporation. The evidence did not satisfy him that there was anything more wrong with the meters than was covered by Clause 5 of the agreement. He did not think there was a warranty that the instruments should measure the actual supply except in conjunction with the right to recalibrate. The plaintiffs had failed to show that the instruments could not be rectified, and they had made out no case by which they could claim to have any other instruments put in the power station than those at present there. They therefore failed upon their claim, and as to the amount they had deducted from the bill, their remedy was not to pay themselves but to bring an action, and there would therefore be judgment for the defendant both upon the claim and the counterclaim, with costs. Judgment for the defendants accordingly.

BUSINESS NOTES.

"Igranic" Competition.—The Adams Manufacturing Co., Ltd., the well-known manufacturers of motor controlling apparatus which they have sold for many years under the trade name "Igranic," received so many inquiries from their clients from time to time regarding the meaning of the word "Igranic," that they decided to offer a reward of £5 for the best definition of the word. They advertised the competition in the middle of December, and received a large number of replies. In order to secure an absolutely impartial judgment they submitted a selected number of the replies to Mr. Frank Broadbent, M.I.E.E., the well-known consulting engineer, whose experience as examiner in electric wiring to the City and Guilds of London Institute will render his opinion acceptable to all parties. Mr. Broadbent has made his award to Mr. Alfred Cockburn, 9, St. George's Square, London, S.W., whose definition he adjudges the best as regards form, composition and definiteness. The definition is as follows: Inspires confidence; Gives satisfaction; Requires no attention; Acts automatically; Never goes wrong; Is immensely popular; Combines cheapness with efficiency. The Adams Manufacturing Co., Ltd., point out that the word "Igranic" is a coined word and has no special definition or derivation.

The German Cable Syndicate.—It is stated by one of the firms constituting the German Cable Makers' Syndicate that the combination, the renewal of which was announced several months ago, has been prolonged until the end of 1914. It is also mentioned that the restriction of sales introduced by the syndicate only relates to certain manufactures, and also applies solely, as might be expected, to the German domestic market.

New Factory.—A Wolverhampton paper understands, "upon the most reliable authority," that negotiations have for some time been pending between the Wolverhampton Industrial Development Committee and a London syndicate for the introduction to the borough of a new industry for the manufacture of portions of electric lamps. These have hitherto been manufactured abroad, but under the new Patents Act of the late Liberal Government the parts have now to be made in England.

Specification Deposits.—The municipal authority of one of our largest towns issued an advertisement asking for tenders for certain electrical goods, a fee having to be paid for the specification, which fee was not to be refunded. The matter was taken up with the town clerk by the National Electrical Manufacturers' Association, with the satisfactory result that he has informed the secretary of the Association that the amounts will be refunded to all firms who have sent in *bona-fide* tenders.

Projected Aluminium Combine.—A Berlin dispatch to the *Financial News* reports that the projected combine of Continental aluminium works has not been entirely abandoned, and that negotiations in this direction will be taken up. In the meantime, prices of the metal have been increased from M. 141 to M. 144·50 per 100 kg. This increase is said to be chiefly due to an important purchase of aluminium for American account, and it is further reported that, in interested circles, the opinion is prevailing that this deal has a speculative character.

Book Notices.—*The Universal Electrical Directory (J. A. Berly's)*, 1910. London: H. Alabaster, Gatehouse & Co.—This Directory, which was issued from the press last week, has reached its 29th edition. It consists of between 1,500 and 1,600 pages of matter, which has been thoroughly revised, making it a complete directory of the electrical and allied industries. It already has so many users and friends among our readers that the nature and extent of its contents hardly need describing here, but for the benefit of the large number of men in the electrical profession and industry who even to-day are not using any directory of the kind at all, we may say that its first 800 pages contain full alphabetical and classified information regarding all who are connected with the profession and industry in the United Kingdom, as well as a geographical section which, to the traveller concerned with electrical and other manufactures, is nothing short of indispensable. We have tried it ourselves, and know. Before leaving this first half of the book—the "Red Book," as it is called—reference should be made to the greatly amplified section devoted to "Specialities—Electrical, and Trade Marks." Buyers of electrical supplies who many times a week ask us on the telephone for the names of makers of such and such a speciality, will very often find here just the information they require. Here, again, we have tried it ourselves, and know. It classifies manufactures according to the registered or trade name of the article, and gives the name and address of the manufacturer or agent. As to supply voltages and other suchlike information, as we have fewer inquiries of this kind through our telephonic inquiry department than used to be the case, we assume that the section in which this kind of matter appears, and the Electrical Review Annual Electricity Works Sheets, are, as they become better known, being found to meet the case. If you want to know the voltage, character of current, and anything else about either a home or foreign electrical undertaking, first consult pages 497 and 969 of this Directory, and then let the publisher know if you do not find it. As to the last half of the Directory, this is of greater importance this year, owing to the increasing interest that is being taken in electrical trade with the Colonies and foreign parts generally. A Colonial and General Section, arranged alphabetically as to place and name, is followed by a section giving the same information classified as to trade. Continental and American alphabetical and classified departments bring up the rear. We believe that the Directory has a useful purpose for every man who buys or sells electrical manufactures, either at home or abroad.

Plant Extensions for Fremantle, W.A.—The Fremantle Tramways and Lighting Board have recently placed contracts for the extension of their generating station. Messrs. Splatt, Wall & Co., of Perth, W.A., have secured the contract for the boiler, which will be of the water-tube type, made by Messrs. Danks & Co., of Oldbury. The heating surface of the boiler is 4,000 sq. ft., and a superheater is to be provided giving 120° F. superheat at a working pressure of 160 lb. per sq. in. Mr. Frank Broadbent, consulting engineer, 4, Queen Street Place, E.C., is supervising the construction and attending to the shipping on behalf of Splatt, Wall & Co.

Callender's Hospital Fund.—The seventh annual report of Callender's Hospital and Distress Fund, for the year 1909, of which we have been favoured with a copy, was presented at a meeting held at the works on January 29th, Mr. T. O. Callender presiding. It shows that the weekly subscriptions (one penny) amounted to £187 as compared with £183 last year. Every employé of the Callender's Cable, &c., Co., is a member. The company gave as usual a generous donation (£50), Mr. T. O. Callender subscribed £5, and there were seven other subscribers of £2 2s. each. Annual awards were made to a number of hospitals and other institutions to the amount of £194, against £209 in the previous year. A large number of hospital letters were issued to members, also surgical appliance letters, Convalescent Home letters, and grants for spectacles; financial assistance was granted in 44 cases. The balance in hand is £67.

Buenos Ayres Exhibition.—We have received from the British Commissioner for the Buenos Ayres Exhibition of Railways and Land Transport that is to be held this year, printed particulars as to the classification of exhibits, position and area allotted to Great Britain, transport facilities, motive power, light and water supplies, charges for space, desirability of publishing lists in Spanish, accommodation for exhibitors' representatives, and other matters of interest to the firms in this country who have resolved to exhibit their manufactures. Copies can be obtained from the office of the British Commissioner for the Exhibition, Board of Trade, Queen Anne's Chambers, Westminster, S.W.

New Works.—A correspondent states that large electrical engineering works are about to be erected at Abbey Park, St. James', Northampton, a site of five acres having been acquired for this purpose.

Tantalum Lamps for Traction Work.—A large number of tantalum lamps have been installed on one of the Underground Tube Railways of London, and have scored a notable success; the following results have been supplied as a sample of their performance:—Six lamps which burned for 6,084 hours are still good, and a further six lamps which have given out burned for an average of 5,167 hours, the shortest life being 4,032 hours and the longest 7,218 hours. The lamps used were of 2·2 watts efficiency, burning five in series on a 600-volt circuit. As compared with carbon-filament lamps the amount of light is greater, and there is, at the same time, a considerable reduction in the current consumption. These excellent results are, no doubt, due to the construction of the filament of the tantalum lamp, which is a drawn wire, having a greater tensile strength than mild steel of the same gauge, and the length of each loop of filament is particularly short, so that the lamp may be installed in any position, and is capable of standing vibration of extreme severity. We understand that the suppliers of these lamps, Messrs. Siemens Bros. Dynamo Works, Ltd., Tyssen Street, Dalston, London, N.E., have for some time manufactured tantalum lamps at their Dalston Works.

First Meeting.—*Re* Platt & Bleasdale, Victoria Square, Bolton, electrical engineers.—The first meeting of creditors was held in Manchester on Friday. Mr. Thomas H. Winder, Official Receiver of Bolton, presided. The debtors' statement of affairs showed that the gross liabilities were £1,495, of which £1,439 was expected to rank. The assets showed a deficiency of £49. The debtors began business as electrical engineers in Bolton in 1897 with a capital of £200. The business proved profitable, but their capital became locked up in stock and investments in shares taken by them for the purpose of securing contracts. The debtors stated that they did not regard their business as being insolvent, and that if capital were provided to complete the work in hand a surplus of assets over liabilities would be obtained. A resolution was adopted to the effect that the debtors be adjudged bankrupt; and Mr. Harold Mather, of Acresfield, Bolton, was appointed trustee of the property on behalf of the creditors, with a committee of inspection.

Dissolutions and Liquidations.—Horsfall Destructor Co., Ltd.—A petition for winding up this company, presented by the Earl of Dudley's Round Oak Works, Ltd., is to be heard in London on February 8th.

London Electrobus Co., Ltd.—At a meeting held at 54, New Broad Street, E.C., on January 17th, it was resolved to wind up voluntarily with Mr. T. J. Garlick, 15, George Street, Mansion House, E.C., as liquidator.

Mitcham Electric Fan Co., Ltd.—This company is winding up voluntarily, a scheme having been adopted for the transfer of its business, and also that of the Dynamic Syndicate, Ltd., and the Dynamic (French) Syndicate, Ltd., to a new company. Mr. A. Goodlet, 6, Broad Street Place, E.C., is liquidator of all three companies.

Santoni Arc Lamps and Engineering Co., Ltd.—A meeting is to be held at 11, Queen Victoria Street, E.C., on March 2nd, to hear from the liquidators (Messrs. W. M. Whyte and G. E. Corfield) an account of the winding-up.

Rex Electric and General Supplies, Ltd.—A meeting will be held on March 2nd at the office of the liquidator (Mr W. M. Whyte, 11, Queen Victoria Street, E.C.), to hear an account of the winding-up.

Williams & Dawson, electrical engineers, St. Paul's Road and Avenham Street, Preston.—Messrs. F. Williams and J. Dawson have dissolved partnership. Mr. Dawson will attend to debts and continue the business as Dawson & Co. at the same addresses.

The "X" Syndicate, Ltd.—A compulsory winding-up order having been made against the "X" Syndicate, Ltd., the first meetings of the creditors and shareholders were held on Wednesday last week at the Carey Street offices of the Board of Trade, before Mr. W. J. Warley, Official Receiver. The accounts filed under the liquidation showed liabilities £5,301, against assets valued at £4,425, and a deficiency of £1,882 to the shareholders. The syndicate was formed in March, 1908, with a nominal capital of £2,000, to acquire and carry on the business of manufacturers of electrical secondary batteries, formerly carried on by the "X" Electrical Accumulator Co., Ltd. The latter company, it is stated, had been negotiating with the Admiralty for the supply of storage batteries, and it was thought probable that a substantial contract would ultimately be made. A Receiver was in possession of the assets of the old company on behalf of a debenture-holder, but he was unwilling to supply funds to carry on the negotiations. Mr. Opperman, a director, stated that he, in conjunction with other shareholders of the old company, promoted the present syndicate to take over the assets and undertaking from the Receiver, and to find funds for the necessary manufacture of sample batteries, and to continue the negotiations with the Admiralty. An agreement, dated April 27th, 1908, was entered into between the Receiver for the debenture-holder of the old company and the present syndicate, by which it was agreed that the former should sell to the syndicate the assets and undertaking of the old company, including plant, machinery, patents, &c., the consideration being £3,500, to be satisfied by the issue of a debenture for £3,700 bearing interest at 6 per cent. per annum, and the allotment to the vendor, as fully paid, of ordinary shares in the capital of the syndicate to the extent of 5 per cent. of the nominal capital. The shareholders of the old company were informed by a circular, dated May 15th, 1909, that 950 shares would be reserved for subscription by them for seven days, and that arrangements had been made whereby the whole of the capital would be subscribed in any event. No evidence has been produced of any such arrangement; 907 shares have been issued for cash and are fully called, in respect of which there is £7 unpaid. In accordance with the above agreement the assets were transferred, and on July 23rd, 1908, debentures for £3,700 were issued to the vendor, and according to the books of the syndicate cash payments amounting to £507 were made in respect of the further consideration. The fully paid shares referred to in the agreement have not been allotted, although they have been taken into account in the books. By an agreement of June 17th, 1908, Mr. Opperman was appointed manager of the syndicate at a salary of £500 per annum, with the right to a call, for a period of 12 months, of 1,500 of the deferred shares. This call has not been exercised. He is a creditor for £146 in respect of salary. The result of the syndicate's trading as shown by an account made up to June 24th, 1909, has been a loss of £1,395. The working capital of the syndicate was exhausted by October, 1908, and the syndicate's operations were thereafter carried on by means of advances by the

directors, and an overdraft at the syndicate's bankers guaranteed by the directors. Active operations were discontinued early in May, 1909, and on September 7th, 1909, the secretary obtained judgment and levied execution in respect of unpaid salary. On September 23rd, 1909, Bertram Thomas Rumble, of the estate office, Merton Park, was appointed receiver on behalf of the debenture-holder. The Receiver has since disposed of the whole of the assets, excepting the book debts and patents, and has realised the net amount of £155. The unsecured creditors' claims amounting to £1,259 are mainly in respect of goods supplied, directors' fees and loans. The directors attribute the failure of the syndicate to the breakdown of the negotiations with the Admiralty, and with prospective purchasers of some of the syndicate's foreign patents. In the absence of a quorum both meetings were formally adjourned for one week.

Deed of Assignment.—Walter Ward, electrical engineer (W. Ward & Co., 26, Queen's Street, Neath).—Creditors under this deed of assignment must send in particulars of claims by February 15th to Mr. G. E. Corfield, trustee, Balfour House, Finsbury Pavement, E.C.

Catalogues and Calendars.—The Jandus Arc Lamp and Electric Co., Ltd., Hartham Road, Holloway, N.—Excellent hanging calendar with monthly slips, above which appears a charming reproduction in colour of "Lady Lyndhurst," after a painting by Lawrence.

Messrs. Chambers & Co., advertising agents, of 62, Finsbury Pavement, E.C., have sent us a copy of their "British Manufacturers' Pocket Book." The major portion of its pages are devoted to daily diary spaces for the current year. It contains also some tables of general engineering information, and a list of municipal town clerks, engineers, and surveyors in the metropolitan area.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.—Twenty-four page catalogue of advertising signs and flashers, including "Singleite" signs, fixed outside signs for shop-window and public building purposes, changing-colour signs, "Mirrorgraph" signs, counter signs, outside lanterns, "thermoblink," and other flashers, time switches, &c. The list is fully illustrated and prices are given.

Messrs. Balcke & Co., Ltd., 27, Clement's Lane, London, E.C.—New 24-page catalogue containing a number of small and effective half-tone views of their Balcke low-lift centrifugal pumps, motor-driven and otherwise, together with a description, tabulated dimensions, capacities and prices. These pumps are made in any size from the smallest to the largest, both horizontal and vertical, they are also made for both low and very high lifts.

The Clarence Engineering Co., Ltd, 3, Cherry Tree Court, Aldersgate Street, E.C.—Leaflet showing and describing Denny's lampholder suspension clip attachment, which was described in our issue of December 31st; also a leaflet describing Hatry's patent indicating fuse bridge.

M.S. Lamp Co., 74, Melrose Avenue, Cricklewood, N.W.—Leaflet giving prices, &c., of their "M.S." metal-filament lamps, battery lamps, &c.

Mr. George Ellison, Birmingham.—Calendar for February, showing motor starter for A.C. motor.

Mr. Ellison has also sent us a list reprinting a description of the electrical equipment of the works of Messrs. E. G. Wrigley & Co., tool makers and gear cutters, Foundry Lane, Smethwick, where electric motors have recently superseded gas engines, Mr. Ellison's starting switches, of somewhat novel design, for three-phase induction motors being used.

Messrs. Venner & Co., of 6, Old Queen Street, S.W., have sent us an ash tray, in the centre of which is let in, between glass, a photographic view of the London Coliseum, showing the Venner electric signs which are in use there and form such an effective advertisement. Owing to the limited number of these very acceptable souvenirs that is available, the firm are only supplying them to customers. To any of these who may have been overlooked, one will be sent on application.

The Vincit Co., Ltd., 67, Aldersgate Street, London, E.C.—76-page illustrated catalogue, in which their carborundum and Electrite goods are dealt with at length. The firm are the exclusive manufacturers of carborundum (Acheson's process) in Europe, and the only makers of "Electrite" in the world. Vincit carborundum wheels for grinding, cutting, sharpening, and other purposes are particularised, hints on grinding and directions for fixing the wheels being given, together with notes on calculations of speeds and sizes of pulleys. Many pages contain prices with illustrations of special shapes of Electrite wheels, carborundum files, carborundum and Electrite blocks and bricks, Electrite cloth and paper, and other goods. A loose sheet shows some of the company's grinding machines, twist-drill grinders, saw-sharpening machines, &c.

Messrs H. G. Mayer & Co, 67, Aldersgate Street, E.C.—Price leaflet of Plania flame carbons.

Adnil Electric Co., Ltd., Adnil Building, Artillery Lane, E.C.—20-page illustrated price list (Section D of their catalogue) containing particulars of a variety of wall sockets, plugs, plug boxes, with switches and locking device, plug sockets, adaptors, ceiling roses, branch blocks and fuses.

Siemens Bros. Dynamo Works, Ltd, Caxton House, Westminster, S.W.—22-page price list, 6 E, in which are set forth in full detail, clearly arranged and well illustrated, descriptions and prices of the "Zed" cartridge fuses, distribution boards, and fuse and switch boxes. Also a 12-page pamphlet describing the "Zed" fuse system, dwelling upon its reliability, convenience and general advantages. The company keeps a large stock of the articles set forth in these publications.

Messrs. Jesson, Birkett & Co., Ltd., Salop Street, Highgate, Birmingham.—Some literature relating to the firm's electric fittings. One is catalogue No. 37, in which are shown to scale a selection of designs of electric light fittings in cast metal, which they are now adding to their patterns of wrought-iron. These include some very choice examples of brackets, also pendant and electrolier fittings for lamps and candles. List 38 shows some inexpensive incandescent lamp fittings for small houses and flats. A small booklet accompanying these contains some hints for electrical engineers and contractors on the selection of fittings. Copies of these leaflets can be obtained on application. The firm has a large general catalogue in course of preparation.

Messrs. Krupka & Jacoby, 61-62, Watling Street, E.C.—A number of illustrated price lists of ceiling roses, electric lamps, glass shades for tantalum and other lamps, 25-c.p. high voltage tantalum lamps, "Luxol" electric sign letters, porcelain insulators and Siemens's flame arc lamp carbons.

The Cubitt Concrete Construction Co., 206, Gray's Inn Road, London, W.C.—Thirty-page catalogue, giving information concerning the "Medusa" waterproof compound for building construction, with views of buildings and tests of the material; particulars also appear of the company's white Portland cement.

Messrs. Jackson Bros., Herbert Place, Plaistow, E.—Leaflet showing their "Slipon" shade carrier for electric lamps.

Brush Electrical Engineering Co., Ltd., Loughborough.—Small leaflet bringing forward in popular manner the claims of the Brush "Metallum" lamps, and stating prices of same for voltages from 20 to 250, and candle-powers from 5 to 100.

The Electric and Ordnance Accessories Co., Ltd., Aston, Birmingham.—New catalogue (No. A 43), containing descriptions with illustrations, half-tone and line diagrams, of their Victor arc lamps, including standard enclosed, miniature enclosed and flame types. Instruction for fixing, connecting-up and trimming, also prices and code-words, as well as tabulated particulars, and prices of a variety of arc lamp accessories.

Trade Announcements.—Messrs. Crossley Bros., of London and Manchester, have just appointed Messrs. Courtney and Birkett (proprietor, Mr. Vincent S. Allpress, M.I.C.E.), of Southwick, near Brighton, sole agents for Kent, Sussex, Hampshire, and the Ise of Wight, for the sale of their marine engines and accessories for motor-boats and fishing boats, &c. Messrs. Courtney & Birkett (to whom all inquiries should be directed) have allocated one of their engineering shops for testing and other work in connection with the fitting up of these marine motors.

J. & G. Odhams, wholesale ironmongers and manufacturing electricians, 206 and 207, Upper Thames Street, E.C.—Mr. John Odhams announces that he has transferred the business, &c., to his son, Mr. M. G. Odhams, who will continue under the same firm style, and will attend to debts, &c.

The Hoffmann Manufacturing Co., Ltd., Chelmsford, inform us that in consequence of the steadily increasing demand for their manufactures, they have extended their power plant, and have just given a contract for a 330-H.P. combined Diesel oil engine and dynamo for their works.

Messrs. Plutte, Scheele & Co., Ltd., have been appointed sole agents for Australia, Tasmania and New Zealand for Watson's patent D.P. switch and fuse, which is being manufactured by the Northern Electrical Co., of Grimsby.

Following the notice that appeared on page 137 of our last issue, we are informed that there was registered on January 13th the company, Accles & Pollock, Ltd., which has now taken over the business of Oldbury Steel Conduits, Ltd.; the latter company, as stated last week, is in process of voluntary liquidation in order to carry out the amalgamation. All inquiries and orders for the specialities of Oldbury Steel Conduits, Ltd., consisting of their "Oldbury" steel conduits and fittings, and particularly their patent roller fittings, should now be addressed to Accles & Pollock, Ltd., Oldbury, Birmingham. Their London office and stores will continue as before, at Rochester Row, Westminster, S.W., their London agent being Mr. Louis G. Milne.

The Key Engineering Co., Ltd., announce that for the sake of convenience they have transferred their Manchester offices to their works at Trafford Park, and in future their Manchester address will be Elevator Road, Trafford Park. Telephone number, 4945 Central.

Mr. Chas. Pullan, of 51, King's Arcade, Bradford, announces that he has closed his contracting department, and will henceforth devote himself strictly to consulting work and supplies of electrical materials. Mr. George Newby (Jas. Davies & Co.) 51, Tyrrel Street, Bradford, has taken over the contracting department.

Bankruptcy Proceedings.—Wilson Rae, "lately an electrical therapeutic specialist," 43, 44, New Bond Street, London, at date of filing petition standing committed for trial, and residing at H.M. Prison, Brixton.—Receiving order made January 26th on creditor's petition. First meeting, February 10th; public examination, February 25th.

R. Foster & W. Baker (R. Foster & Co. and Nelson Electrical Engineering Co.) Nelson and Burnley, plumbers' merchants and electrical engineers.—February 12th is the latest date for the receipt of proofs for intended dividend, by Mr. C. H. Plant, 13, Winckley Street, Preston, trustee.

Samuel Emesson Smith, electrical engineer, Coulby House, Carholme Road, late of 271, High Street, Lincoln.—This debtor attended at the Sessions House, Lincoln, last week, for his adjourned public examination, but was not further questioned.

Wm. Aubert, Jun., gas and electrical engineer, Taggs Island, Hampton Court.—February 21st is the last day for the receipt of proof for intended dividend by the trustee, Mr. L. B. Linnett, 42, Poultry, E.C.

LIGHTING and POWER NOTES.

Ainsdale.—The question of electric lighting is again under consideration, and inquiries as to the probable number of consumers are being made by the Birkdale and District Electric Supply Co. Many new houses have been wired in the district.

Aston Manor.—The Electricity Committee of the T.C. has recommended extensions at the electricity works at a cost of £13,550, for which sum sanction to a loan is to be asked. It is proposed to install a 2,500-KW. turbo-generator and condenser, a water-tube boiler, a 250-KW. motor-generator for converting purposes, a 350-KW. rotary converter and a small balancer, and high and low-tension switchgear to control the new machines.

Burnley.—The T.C. is asking the L.G.B. for sanction to a loan of £2,500 to cover expenditure on mains for the next three years.

Cardiff.—With reference to our note under this heading last week, we understand from Mr. Arthur Ellis that the £18,000 for mains extensions has already been covered by previous sanctions, and is not, as was suggested, the subject of an application to the L.G.B.

Continental Notes.—BELGIUM.—It is reported from Brussels that a group of Belgian banks and Luxemburg manufacturers is investigating a scheme for the electrical distribution of power to the heavy industries in Luxemburg. It is proposed for this purpose to construct a dam across the river Sure, near Boulaide, and to erect electricity works, and land for the purpose is said to have already been acquired. The expenditure on the works is already estimated at £480,000.

ROUMANIA. — The communal authorities of Focshari have obtained powers to contract a loan of £40,000, a considerable amount of which is to be utilised for electric lighting purposes.

Coventry.—The T.C. has decided to apply for a loan of £34,000 for electricity purposes.

Eastleigh.—At the monthly meeting of the U.D.C., the following report was unanimously adopted: "The Electricity Sub-Committee has gone into the question of the Electric Lighting Order for the Urban District, and recommends that, if the Council considers electric lighting desirable, then the monopoly should be offered to some private company for a period of years, giving the Council option to purchase on terms to be arranged later."

Glais.—In connection with the Swansea R.D.C. scheme, the village of Glais, in the Swansea Valley, was on Wednesday evening publicly lighted by electricity. The supply is obtained from a colliery power station, which, by arrangement with the District Council, has been enlarged for the purposes of public lighting. The plant includes a Hornby suction gas engine and Crompton dynamo, a 120-cell battery, &c., and supplies energy at 220 volts for street and private lighting. The public lighting consists of 34 lamps of 32 C.P., and two of 50 C.P., of the Osram type. Mr. Higgs, Swansea, was the engineer in charge of the works, and Mr. Blake was consulting engineer.

Grays.—At a meeting of the U.D.C. on January 27th a letter was received from three firms of local engineers protesting against what they considered "the unfair and pernicious system" of the electrical engineer (Mr. E. D. Long) in competing with electricians and others in work done. They expressed the opinion that all work done by the Council should be contracted for. The chairman said that the Council very carefully considered the matter a few months ago, and he saw no reason for change. He moved that a reply should be sent to that effect. Mr. Long stated that he did his utmost to co-operate with local contractors, and did not in any way interfere with their business. Mr. T. N. Banks said he believed that the work done by Mr. Long only amounted to about £100 a year, and it was only in the case of public buildings. The chairman's motion was carried.

Greenock.—Speaking at a function in Greenock, Provost M'Miller, the chief magistrate, said that with reference to the supply of electricity for the Clyde torpedo factory, the original estimate was for a supply of 250 H.P., but now they had information that the minimum demand would be for 500, and they were to lay cables for 750 H.P.

Haydock.—The U.D.C. is negotiating with the Lancashire Electric Power Co. for the extension of the lighting mains to the district.

Honduras.—A 20-year concession has been granted by the Government to J. W. Grace, representing the Puerto Cortez and Baracoa Electric Co., for the erection of an electric light plant at Baracoa or Puerto Cortez. The company will furnish electric light to the neighbouring towns and power to tramways, railways and industrial enterprises. Permission is given for the construction of telegraph and telephone lines. Another electric light concession has been granted to Manuel E. Lardizabal, for a period of 20 years, for the installation of an electric light plant in the city of San Pedro Sula. The company will operate under the name of "Empresa de Luz Eléctrica de San Pedro-Sula," and will supply light and power for various purposes.—*Commercial Intelligence.*

Hounslow.—At the last meeting of the U.D.C. it was reported that there was a clear profit for the year on the electricity undertaking of £440, as against £80 in 1908, and a deficit of £62 in 1907. For 1909, the income was £7,861, and the works expenditure £3,330, leaving a surplus of £4,127, which payment of interest and instalments of loans reduced to the amount mentioned. It was further reported that satisfactory progress was being made in regard to the coming Electrical Exhibition which will commence on February 17th, and be continued to the 26th.

Hull.—A deputation of the Hull Electrical Contractors' Association waited upon the Electricity Committee of the T.C. on January 17th, with respect to the disposal of consumers' old lamps by the Corporation. Alderman E. Hanger, J.P. (chairman of the Committee), assured the deputation that the department was not intending to sell lamps, but it wanted to give information to large consumers as to where they could get the best value for their old lamps. Mr. A. Shaw (chairman of the Contractors' Association) pointed out that there was practically no market for old lamps, but they had attended under the impression that the Committee was going to supply radiators and fittings. It was again pointed out that there was no intention of trading of any description, but Mr. Appleyard replied that the Corporation had opened a show room, and the fear of the Association was that it might develop into a selling place where, perhaps, fittings would be sold at cost price, and perhaps less. The deputation was told that the Corporation had no power to trade in lamps and fittings. Mr. W. L. Harrison referring to the sale of motors, expressed a hope that when they were bought outright by consumers, the Committee would get a fair profit, so that private traders would not be placed in an invidious position.

Keighley.—The T.C. has received sanction to loans of £15,400 for generating plant, £1,000 for transformers, £4,340 for mains, and £260 for services.

London.—WESTMINSTER.—In regard to the termination of the contracts for street lighting with the Gas Light and Coke Co., and which contracts are to end for low-pressure gas lighting on March 31st, and for high-pressure lighting on December 31st next a sub-committee has been appointed to consider the present conditions of public lighting and obtain competitive tenders.

FULHAM.—The Electricity Committee report having had under consideration the charge to be made for energy supplied for driving motors, used for the purpose of producing other artificial light, which is, of course, in direct competition with the Council's undertaking. In future, energy supplied for this purpose will be at the rate of 3½d. per unit, with a minimum charge of 13s. 4d. per quarter, plus the usual motor rent.

Plymouth.—The Electricity and Street Lighting Committee has decided to revise the charges to the Tramways Committee, to private consumers using motors, and to electrical contractors, as from April 1st next, in the following manner:—The charge to the Tramways Committee to be 1¾d. per unit up to 750,000 units per annum, all in excess of that quantity to be charged at the rate of 1½d. per unit. The present charge is 1¾d. per unit for any quantity, and last quarter the supply to the tramways amounted to 306,233 units, representing about 1,200,000 units per annum. The charge to private consumers for motor purposes will be 1¾d. per unit up to 100 units per quarter, and in excess of that quantity 1½d. per unit. At present the charge to that class of consumer is 1¾d. per unit. The charge proposed to be made to electrical contractors for supply for business purposes is a flat rate of 2d. per unit for lighting or motor purposes.

The estimates for the next financial year were approved as follows:—On the electricity undertaking, the income is estimated to produce £24,750 as against £23,600 this year. The expenditure, other than interest and sinking fund charges, is estimated at £14,630, compared with £13,240 in the current year, the increase being mainly due to the recent reassessment of the electricity undertaking, which necessitates the payment of an additional sum of £1,000 in rates. After allowing for interest and sinking fund charges, it is anticipated there will remain a credit balance of £497, as against £670 estimated this year. The capital expenditure in the ensuing year is estimated at £3,750 for cable extensions, meters, transformers and a new turbine, but of that amount £2,500 will be met out of the reserve fund, leaving only £1,250 to be borrowed. On the street lighting account the expenditure is estimated at £6,916, as against £7,090 in the present year.

The electrical engineer submitted a return upon the working of the undertaking for the quarter ended December 31st last. It showed a sale of 730,318 units, producing estimated receipts of £7,924, as compared with 683,494 units sold and £7,423 received in the corresponding period of the preceding year. The receipts from the supply of energy to the tramways amounted to £2,233, as against £2,088; for private lighting they yielded £4,518, compared with £4,330, and for private motors £344, as against £216. At the end of last month the number of consumers was 1,104, compared with 980, and the lamp connections totalled 86,339, against 76,878.

The engineer was instructed to submit a report on the practicability and cost of allowing the employés of the Committee one day's rest in seven.

Port Glasgow.—For some time past negotiations have been in progress between the T.C. of Port Glasgow and that of Greenock for a supply of energy to the former burgh. Committees on each side were appointed, and at a meeting of those last week it was decided that Greenock Corporation should submit terms for a supply of electricity to Port Glasgow.

Southampton.—The borough electrical engineer reported at the last meeting of the Council that a marked increase of load commenced as early as the beginning of October; in fact, on the first of that month there was an increase on the direct-current

lighting, of about 25 per cent., and on the alternating-current lighting, of about 20 per cent. as compared with last year. He was of opinion that it was most necessary to increase the generating plant. Some six years ago they were in the unfortunate position of having to refuse new customers through being short of plant, and they had never yet recovered from that set back. The engineer suggested that the following plant would give a suitable reserve:—One 2,000-ampere D.C. machine; one 3,000-KW. alternator, one 200-KW. motor-alternator, and one boiler. The cost of the above will be £13,000, while the earning capacity of the plant will be about £6,500 per annum. He thought it was only reasonable to expect a similar increase next year to what they had experienced this year. They might also expect a largely increased demand from the tramways department in the immediate future. As regards the increase in the alternating plant, this would be accompanied by a marked increase of efficiency and reduction of working expenses. The saving in coal consumption on the three alternating sets at present used would be about 25 per cent. The report was adopted by the Council, and it was decided to apply to the L.G.B. for sanction to borrow £13,000 for the additional plant. It was further decided to substitute electric lighting for gas in five streets.

Warrington.—Application has been made to the B. of T. by Messrs. G. H. Cox and H. J. Falk, of Liverpool, for powers to supply electricity throughout the area of the Rural District Council of Runcorn. The Town Clerk of Warrington has entered objections.

Wrexham.—The T.C. has adopted a new scale of charges for supply to theatres and music-halls, viz., over 5,000 units and under 8,000 per annum, 3½d. per unit; over 8,000 units, 2½d. per unit, less ½d. per unit for prompt payment.

TRAMWAY and RAILWAY NOTES.

Bacup.—On Tuesday (February 1st) a public inquiry was held at Bacup by order of the Light Railway Commissioners, by Col. G. F. O. Boughey, R.E., C.S.I., and Mr. Henry Allan Steward, into an application of the Bacup Corporation for sanction to construct a light railway or electric tramway along Rochdale Road, from the centre of Bacup to Shawforth, to join the Whitworth section of the Rochester tramways, and so secure a through service between Bacup and Rochdale, and *vice versa*. The town clerk of Bacup (Mr. J. Entwistle) stated that it was proposed to construct a tramway 1½ miles in length, and the gauge of which was to be 4 ft. 8½ in. They had arranged to lease the line to the Rochdale Corporation, who would work it for 30 years, at the end of which period it would be handed over to the Bacup Corporation as a going concern. There were no engineering difficulties, and there was plenty of land available if the Corporation required it for the purposes of a car-shed. It was proposed to work the line on the overhead trolley system, and the energy required would be supplied either by the Bacup Corporation or by Rochdale themselves. Evidence was given by Mr W. H. Elen, A.M.I.C.E., borough engineer of Bacup, and by Mr. J. S. D. Moffett, engineer, of Rochdale, who stated that the estimated cost of the new line was £24,038, made up as follows: For permanent way £3,395 (single line), £2,736 (double line); excavating, &c., £7,262; electrical equipment overhead, &c., £2,054; feeder cables, £500; six cars and tower wagon, £4,900; car-shed, £1,000; contingencies, £2,189; total, £24,038. The estimated receipts would be £3,750 at 10d. per mile for 90,000 car-miles per annum, and the working expenses were estimated at 6d., so that the line would pay.

Belfast.—A special meeting of the City Council was held on January 31st to take into consideration the recommendation of the Tramways and Electrical Committee to promote a Bill to acquire the Cavehill and Whitewell Tramway Co.'s line at a price to be fixed by the B. of T. arbitrator. This was agreed to with only one or two dissentients. It is hoped that this much discussed question will now be finally settled one way or the other.

Black Country.—The Tramways Committee of the Dudley T.C. has appointed a deputation to join the Chairman of the Dudley Chamber of Commerce in order to wait upon the tramway companies respecting the fares. At the monthly meeting of the Tipton T.C. last week, Mr. Powell said that when the "fair fare" system was brought before the Council, it was distinctly stated that workmen's fares would not be altered. He found that on workmen's cars a penny more was being charged from Handsworth to Great Bridge, and 2d. more for the whole journey to Dudley. Mr. Peake said as far as he could learn the fares generally had been increased by about 50 per cent. It was claimed on behalf of the company that the new system would prove a convenience to the general travelling public, but instead of giving something, the company were taking something away. It was ultimately decided to protest against the additional fares, and to ask the company to revert to the original charges. A protest meeting was held at West Bromwich last week, when it was stated that at a previous meeting a boycott of the company had been decided upon, and that as a result of that effort 1,100 people had pledged themselves that for three months they would not use the cars in that district unless they were absolutely obliged. Those pledges had only been obtained in a casual way, and the Committee were hopeful of so spreading the movement that they would get at least 10,000 West Bromwich people to join it. It was also stated that Smethwick would join in the boycott, and they were also hopeful of enlisting the sympathy of Darlaston and Wednesbury people in the movement.

Cardiff.—Six months' trial of increased tramway fares has, says Mr. Ellis, resulted in 76,281 less passengers being carried, and £117 10s. extra revenue being obtained.

Chester.—There was a recommendation at the meeting of the City Council on January 26th, authorising the Tramways Committee to have five regenerative cars altered to the old type of equipment, at an estimated cost of £400. The chairman of the Committee said the new cars under the new system had been a continual source of expense. These cars were got on the advice of the electrical engineer, backed by the recommendation of other authorities, as a satisfactory up-to-date system. The recommendation was adopted.

Continental Notes.—GERMANY.—The work in connection with the conversion to electric traction of the railway between Dessau and Bitterfeld, which has a total length of 16 miles, and is used both for goods and passenger traffic, will be commenced in the spring. The line forms part of the scheme for the electrical transformation of the railway between Magdeburg, Zerbst, Leipsig and Halle, of a total length of 95 miles. It is intended to use the single-phase system as adopted on the State railway between Blankenese and Ohlsdorf, to employ alternating-current locomotives having a trolley pressure of 10,000 volts. The power station is being erected at Muldenstein, which is three miles distant from Bitterfeld, and where ample supplies of lignite as fuel are available. The orders for the work are stated to have already been placed with the largest firms, and the railway is to be ready for service in the autumn.

Plans are being prepared in respect of a projected electric tramway between Hanau and Crossanheim (Hessen-Nassau).

HOLLAND.—La Société des Tramways de Flessingue Middelbourg et Extensions, which some time ago secured a new 50 years' concession for its tramways and authority to convert the same to electric traction, has also obtained a 25 years' concession from the municipal authorities of Flushing for the electric lighting of the town and for the construction and working of an electric tramway between the railway station and the town. Work is well in hand on the establishment of a central generating station, which will not only be able to supply energy for the electric lighting of the town and for the working of the tramways, but also for the lighting of the villages in the district.

FRANCE.—A daily paper says that the net receipts of the Paris Metropolitan Railway for 1909 were 29,920,700 fr. (£1,196,800), 2,900,100 fr. (£116,000) more than for 1908.

Dublin.—Owing to the snapping of some telephone wires, which fell across the trolley wires near the Kingsbridge terminus, and then dangled in the street, three horses which came into contact with the wires were killed, and a young man was injured. Accidents of this kind are fortunately rare; it was recently pointed out that in connection with Manchester's 200 miles of overhead trolley wires, the wires had only been down six times in six years, and with no ill result.

East Ham.—The T.C. has considered a proposal from the Ilford Council to the effect that it is prepared to cancel the present agreement for the leasing of the Ilford Hill portion of the tramway track, and to enter into a fresh agreement, including the following terms:—(1) For East and West Ham cars of the present type to run at the rate of 6d. per car-mile as at present; (2) for L.C.C. cars at the rate of 7d. per car-mile to cover the increased cost of current consumed and maintenance incurred by reason of the weight and size of such cars. The East Ham Tramways Committee cannot agree to the increased cost for the L.C.C. cars.

Haslingden.—At a meeting of the Council on January 26th, it was reported that at a conference of representatives of Accrington, Rawtenstall and Haslingden Corporations, it seemed apparent that all three authorities desired to bring to an early end inconvenience to the travelling public, and the loss of traffic receipts, occasioned by the enforced change of cars at the boundary of Haslingden and Rawtenstall. It is hoped to arrange for a three months' trial of through running, and also for arbitration if the three authorities cannot agree to terms.

Leyton.—Application is to be made to the Board of Trade for sanction to borrow £600, the estimated cost of the equipment of cars for use in connection with the through running arrangements with the London County Council to Aldgate.

London.—For the operation of the L.C.C. Woolwich-Eltham route, it is intended to equip a tramways sub-station at Woolwich with four small motor-generators, thrown out of use at the Elephant and Castle sub-station. Switchgear and other plant will be required, at an estimated cost of £3,325.

At the East London Railway meeting held on January 28th, Lord Claud Hamilton referred to the diminution of passenger traffic, which he thought could not be avoided until the lessee companies enabled the East London line to regain the through traffic by the electrification of the system. He understood that the Brighton Co.'s electrical section was giving satisfaction, and after some six months' working, it might be possible to come to some conclusion as to which system of working to adopt.

At the half-yearly meeting of the Brighton Co., held on Wednesday, the chairman referred to the satisfactory results obtained from the London Bridge—Victoria section which was recently converted to electrical working. He said that the service had proved very popular, and in the first week of operation 40,000 extra passengers were carried, and, moreover, this has been followed by a steady increase from week to week. During the two months of December and January, the passengers had increased by 63 per cent., as compared with the corresponding months of 1908-9, and the company had practically regained the whole of its lost traffic. In view of these results, the advisability of further electrical extensions was engaging the attention of the board. The chairman intimated that they would be willing to co-operate with their co-lessees in electrifying the East London railway.

Quarry Bank.—The B. of T. has granted an extension until July 30th next, of the Quarry Bank, Brierley Hill and Rowley Regis Light Railways Order.

U.S.A.—According to *Electric Traction Weekly*, the Chicago City Railway, reporting the results obtained from the operation of the pay-as-you-enter cars on the Cottage Grove line during 14 months of operation, states that the receipts increased by $121,610, as compared with the previous 14 months' working, while the car-running hours decreased 94,448 hours. The revenue from all the city lines increased 2·8 per cent. during one year, but on the Cottage Grove line the increase was 7·2 per cent., showing a decided benefit from the pay-as-you-enter car. It is pointed out that these cars have increased revenue, cut down running hours, subtracted one-third from accidents incidental to boarding and leaving cars, cut down expenses, and have eliminated disputes over fares, &c.

The first and only 15-cycle single-phase railway in the States has been operating successfully for two years between Visalia and Lemon Cove, California, a distance of 22 miles. Three-phase energy at 60 cycles and 35,000 volts pressure is purchased and converted at a centrally-situated sub-station to 15-cycle 11,000-volt single-phase current, which is fed 8 miles in either direction to step-down transformer stations supplying the line at 3,300 volts. The overhead work is of the single catenary bracket type, with poles spaced 120 ft. apart, and the rolling stock includes a 47-ton Baldwin-Westinghouse loco. with four 125-H.P. Westinghouse series compensated single-phase motors and four 40-ton passenger cars, each equipped with four 75-H.P. motors. Pantograph trolleys are fitted to all stock, and the operating speed is 45 miles per hour.

Wigan.—The tramway manager reports that since September 30th last, the energy consumption has shown an alarming increase. For the 15 weeks from October 1st, 1909, to January 20th, 1910, the consumption had increased by an average of 2,186 units per week, in spite of the average decrease of 856 car-miles per week during that period. In other words, the average consumption per car-mile in units had increased from 1·54 to 1·70. A master meter is to be fixed at the electricity station, with a view to determining whether the present meters are working correctly, and the cars on the Standish route are to be fitted with meters for the purpose of ascertaining the energy consumption per car.

TELEGRAPH and TELEPHONE NOTES.

Brazil.—The Western Telegraph Co., according to Reuter, has instituted an action against the Brazilian Government and Mr. Richard Reidy for the cancelling of a concession granted to the latter for the working of submarine telegraph cables on the coast of Brazil. The concession authorises the establishment and maintenance of a coastwise cable service extending from the mouth of the Amazon to the southernmost point of the Brazilian coast. Such a cable service, if actually established, will prove a serious competitor of the British cable company, which now enjoys the exclusive privilege for submarine cable service along the Brazilian coast, except for the telegraph service of the Government.

Cheaper Cables.—According to *Commercial Intelligence*, the Governments of Australia and New Zealand are taking action to press upon the Pacific Cable Board the desirability of instituting a system of deferred telegrams between Europe and Australasia. Such messages, it is suggested, would be dispatched within 24 hours of the time when they were handed in, and the charge would be 1s. 6d. a word for code words, 1s. a word for ordinary words.

Frankfort-Vienna.—The new trunk telephone line between Frankfort, Nuremberg and Vienna was brought into use on January 1st. The charge for three minutes' conversation is M. 3.—*E.T.Z.*

New Cable.—On January 11th the laying of a new cable between Italy and the island of Sardinia was completed by Messrs. Pirelli & Co., of Milan, who since 1905 have been responsible for the upkeep of the first cable, laid in 1875. The maximum depth reached by the cable is about 700 fathoms.

Norway.—Arrangements are being made for the establishment of a new British-Norwegian telegraph cable between Peterhead and Egersund, Norway, and the cable rate to and from Norway will be reduced next January from 3d. a word to 2½d. at first, and afterwards probably to 2d. The agreement between the Governments will necessitate the purchase of the cable of the Great Northern Telegraph Co.

Telegraphic and Telephonic Interruptions.—Many of the circuits between London and Paris and other French cities have been restored, but up to Wednesday delays were occurring on various routes, and only two of the four telephone circuits between London and Paris were available. A snowstorm in Dublin on Friday disorganised the telegraph system, and over 2,000 telephone subscribers were cut off.

Telewriter Exchange.—According to the *Daily Mail*, the first telewriter exchange will probably be opened in March, at 20, Bucklersbury, E.C. A number of telewriters are already in use in London business houses.

Wireless Telegraphy.—It is stated that the results of the experiments carried out with a view to testing the practicability of establishing communication between Germany and the Colonies have been so favourable, that wireless stations will be erected in German East and South-West Africa, the Kamerun and the German South Sea Colonies for the purpose.

It is stated that there are now in the service of the United States Army a total of 38 wireless telegraph stations, of which 13 are in the United States, 9 in Alaska, 5 in the Philippine Islands, 5 on artillery harbour tugs, and 7 in army transport service. The signal corps has purchased a 2-KW. 100,000-cycle alternator for wireless telephone service.

The agreement between the Postmaster-General and the Marconi Companies, and that between the P.M.G. and Lloyd's, of which we gave the gist in September last, were issued as a Parliamentary White Paper last week.

The report of the officers who attended the conference on the question of establishing wireless stations in the Pacific is expected to recommend purely Government control in lieu of the proposed private company, and the scheme recommended will be the linking-up of Australia with other British possessions in the West Pacific by an all-red chain, under the control of the Australian, New Zealand and Fijian Governments.

The Allan Line Steamship Co. has recently commissioned the Marconi International Marine Communication Co. to equip nine of its passenger steamers with the Marconi system of wireless telegraphy.

The Russian Government has proposed to the Government of the United States that wireless communication be established between the island of Kamchatka, in Eastern Siberia, and Alaska.

CONTRACTS OPEN and CLOSED.

OPEN.

Aston Manor.—February 11th. The T.C. wants tenders for one 250-KW. motor-generator and one 350-KW. rotary converter, with accessories. See "Official Notices" to-day.

Australia.—MELBOURNE.—Seven sections of branching multiple magneto switchboard for the P.M.G. See "Official Notices" January 7th.

ADELAIDE.—February 16th. For the P.M.G., ammeters, cords, condensers and condenser telephones.

SYDNEY.—March 9th. Magneto-switchboards for metallic lines and switchboards for private branch exchanges for common-battery working, in accordance with schedule N.S.W.E.E., 114/09 for the P.M.G. Departmental Stores.

Telephone switchboards for New South Wales, and poles (iron or steel) for Western Australia, for the P.M.G. See "Official Notices" to-day.

Wire testing machine, for the P.M.G.'s department in Western Australia. See "Official Notices" to-day.

Ashton-under-Lyne.—February 9th. Condensing plant, cooling tower, exhaust turbine and 400-KW. D.C. generator, and one electric balancer for the Electricity Committee. See "Official Notices" January 21st.

Beckenham.—February 21st. House cut-outs and service boxes, for the U.D.C.

Belfast.—February 21st. Low-tension insulated V.R. cable for one year, for the Tramways and Electricity Department. See "Official Notices" January 28th.

A year's stores for the Tramways and Electricity Committee. See "Official Notices" January 28th.

Belgium.—March 23rd. La Société Nationale des Chemins de Fer Vicinaux (14 Rue de Science, Brussels) is inviting tenders for the supply of the electrical energy required for the electric railways in the Bruges district.

Blackburn.—February 16th. Stores for the Electricity and Tramways Departments. See "Official Notices" January 28th

Blackpool.—2,500 yd. of ·5 low-tension single cable (600 volts) for the Electricity Department. See "Official Notices" January 28th.

Bolton.—February 10th. One Lancashire boiler, with superheater, for the Electricity Committee. See "Official Notices" January 21st.

Grimsby.—February 19th. Eighty flame arc lamps for the Corporation. See "Official Notices" to-day.

Halifax.—February 7th. Stores and materials for the Corporation Tramways and Electricity Departments. See "Official Notices" January 14th.

Hornsey.—February 19th. Meters, cables, &c., for the T.C. See "Official Notices" to-day.

Ilford.—February 22nd. Meters, cables, lamps, carbons, &c., for the Electricity Works, for one year. See "Official Notices" to-day.

India Office.—February 15th. The Director-General of Stores, India Office, Whitehall, S.W., is inviting tenders for electric cranes, and wheels and axles.

Linthwaite.—February 11th. Tram rails, fish and sole plates, bolts, tie rods, copper bonds, &c., for 3½ miles of tramway, for the U.D.C. Abbey & Hanson, engineers, 11, Cloth Hall Street, Huddersfield.

Leeds.—February 28th. Annual contracts for coal, cables, meters and other stores for the Corporation. See "Official Notices" January 28th.

London.—February 4th. The Institution of Electrical Engineers is inviting tenders for a complete system of electrically-operated clocks for its new premises. See "Official Notices" January 14th.

BERMONDSEY.—February 14th. Stores for the Electricity and Destructor Works, for the B.C. See "Official Notices" January 28th.

ST. MARYLEBONE.—February 16th. Various materials for the Council's Electricity Department for one year. See "Official Notices" to-day.

ST. PANCRAS.—February 28th. Arc lamp carbons for the B.C. See "Official Notices" January 28th.

WEST HAM.—February 17th. Electrical supplies for the Council. See "Official Notices" January 28th.

Morecambe.—February 12th. Superheaters for two Lancashire boilers for the Electricity Department. See "Official Notices" to-day.

Norway.—February 18th. The Norwegian State Railway authorities want tenders for telegraph material. Particulars may be obtained at the Commercial Intelligence Branch of the Board of Trade.—*Board of Trade Journal.*

Oldham.—February 16th. Electric lighting, &c., installation, switchboard, testing panel, workshop motors, &c., for the Hollinwood Depôt of the Corporation Tramway Department. See "Official Notices" January 28th.

Portsmouth.—Tenders are invited for one year's supplies of appliances, pipes, stoneware mains, stores, street work, &c., from April 15th, 1910, for the electricity supply station, Gunwharf Road, Portsmouth.

February 14th.—Various goods, including electrical and tramway materials, for the Tramways Committee, also coal for the same Committee. See two "Official Notices" to-day.

Rotherham.—February 7th. Completion of electric wiring work, High School for Girls, for the T.C. Spurley Hey, Director of Education, Imperial Buildings.

Sheffield.—February 7th. Electrical fittings for the Corporation Health Committee. Office of the Cleansing Superintendent, Town Hall (returnable deposit, 10s.).

South Shields.—February 7th. Uniforms for Corporation tramway employés. See "Official Notices" January 28th.

Spain.—Tenders have just been invited by the municipal authorities of Hontalbilla (Province of Segovia) for the concession for the electric lighting of the town during a period of 10 years.

March 14th.—Sixty years' tramway concession in north-east Barcelona—from the Calle de Caspe to Vallcarca. Tenders to Dirección General de Obras Publicas, Ministerio de Fomento. Deposit £216. Local representation necessary. An application already lodged will have preferential rights. For further particulars see *Board of Trade Journal.*

Swindon.—February 19th. Steam coal for the electricity works for the Corporation. See "Official Notices" to-day.

Turkey.—February 15th. The *Moniteur Official du Commerce* (Paris) of January 20th, states that tenders will be received at the Ministry of Public Works, Constantinople, for the construction and working of an electric tramway between Niaousta Town (Vilayet of Salonica) and Niaousta Station, on the Monastir-Salonica Railway.—*Board of Trade Journal.*

Walthamstow.—February 25th. Stores for the U.D.C. Electricity and Tramways Departments for 12 months. See "Official Notices" to-day.

Wimbledon.—Tenders are to be invited for the pipe work required for the horizontal Curtis turbine to be installed by the British Thomson-Houston Co., Ltd.

Wolverhampton.—February 12th. General stores for the Corporation tramways for two years. W. A. Luntley, general manager, car depôt, Cleveland Road.

CLOSED.

Australia.—MELBOURNE.—The contract for 634,000 insulators for the Government, for use in the various States, has been awarded to a German firm, which tendered through a local firm, Messrs. Noyes Bros., at the price of £5,300. "The only British tender submitted was for £9,510, from which the inference seems to be that the German tender was a 'dumping' price."—*Commercial Intelligence.*

The same journal says that the "tenders received in reply to the first prolonged invitation for the contract to supply 100,000 insulators, referred to in recent times, have been unsatisfactory, and the Postmaster-General proposes to repeat the invitation. Referring to the first lot of tenders, he replied to a member of Parliament that 'several tenders had been received, but none of them had been accepted, as the conditions were not favourable, and those received for Australian manufacture were considerably above the estimate. It had been decided to re-advertise for tenders.'"

Bedford.—The T.C. has accepted the following tenders:—

British Thomson-Houston Co., Ltd.—A year's supply of meters.
W. H. A. Robertson & Co., Ltd.—Induced draught plant at the Electricity Works, at £275.
Manlove, Alliott & Co., Ltd.—A refuse destructor, at £6,808.

Bexley.—The U.D.C. has accepted the tender of Callender's Cable and Construction Co., Ltd., for concentric feeder cable for private lighting, at £118, and that of Messrs. Siemens Bros. & Co., Ltd., for ·008 street lighting cable, at £103.

Birkenhead.—The Tramways Committee has accepted the tender of the Brush Electrical Engineering Co., Ltd., for covering in the upper decks of 10 of the tramcars, the work to be carried out in conformity with a specification and design prepared by Mr. Wyld, Corporation electrical engineer and tramways manager.

Brighton.—The T.C. has been recommended to accept the following tenders:—

Richardsons, Westgarth & Co.—Double-cylinder Parsons-Brown-Boveri turbine, coupled to a Siemens alternator capable of giving continuously an output of 3,500 KW., with a steam consumption of 14 lb. per KW.-hour at the normal load of 3,000 KW., £11,370.
General Electric Co., Ltd.—One 1,800-KW. induction motor, £1,076 10s., and one 300-KW. induction motor-driven balancing set, £930.
British Westinghouse Electric and Manufacturing Co., Ltd.—High-tension switchgear and accessories, £393 10s.

Bristol.—The Docks Committee has accepted the following tenders:—

Veritys, Ltd.—Eight arc lamps for the fruit store.
Siemens Bros. & Co., Ltd.—Motor for fan at cold stores.
Simplex Conduits, Ltd.—Metallic-filament lamps.

Derby.—The T.C. has accepted the tender of Messrs. Ferranti, Ltd., for a year's supply of meters, and that of Messrs. C. A. Parsons & Co. for a 1,000-H.P. turbine with condensing plant, at £5,203.

Eccles.—The T.C. has accepted the tender of the British Westinghouse Electric and Manufacturing Co., Ltd., for one 150-KW. traction set consisting of a Belliss & Morcom steam engine, a Körting Bros. ejector condenser, and a British Westinghouse direct-current dynamo, for £856. It has further accepted the tender of the Globe Electrical Co., Manchester, at £133, for the electric wiring and fittings at the new Beech Street Council school.

Germany.—It is reported from Berlin that the Allgemeine Electricitäts Gesellschaft of that city has secured a concession from the Government of Oldenburg for the supply of electrical energy for lighting and power purposes in the Grand Duchy.

London.—L.C.C.—The Stores Committee reports that during the Christmas recess it accepted tenders as follows:—

Electric carbons.—Wm. Geipel & Co.; Ships Carbons, Ltd.
Electric fittings.—British Electrical and Manufacturing Co.; Dorman and Smith; General Electric Co., Ltd.; Siemens Bros. & Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.; Veritys, Ltd.
Electric insulating materials.—Micanite and Insulators Co., Ltd.
Electric lamps.—British Tungsten Lamp Co., Ltd., Huyton Quarry.

The Highways Committee recommends that certain special track-work required during 1909-10 be obtained from Hadfield's Steel Foundry Co., Ltd., at a cost of £15,500, in extension of a contract entered into with them in October, 1908.

Salford.—The T.C. has placed an order with the British Insulated and Helsby Cables, Ltd., for non-fouling trolley wire for the Tramway Department, at 8d. per lb.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has ordered four Bennis stokers and compressed-air furnaces from Messrs. Ed. Bennis & Co., Ltd., Little Hulton, Bolton, for 8 ft. 6 in. Lancashire boilers at the generating station, Tame Valley, Stalybridge.

Stone (Staffs.).—The Joint Hospital Board has accepted the tender of Mr. J. Richards, of Longton, for the E.L. and telephone installation at the new hospital, at £356.

FORTHCOMING EVENTS.

Northampton Institute Engineering Society.—Friday, February 4th. Paper on "History and Manufacture of Electric Glow Lamps," by Mr. L. Wallis.

Society of Engineers.—Monday, February 7th. At 7.30 p.m. At Caxton Hall, Westminster, S.W. Presidential address by Mr. D. A. Symons.

P. & O. Batti-wallahs' Society.—Monday, February 7th. At 8 p.m. At the Holborn Restaurant. Smoking concert.

Institution of Electrical Engineers (Manchester Section).—Tuesday, February 8th. At 7.30 p.m. At the University, Manchester. Paper on "Three-Wire Balancers," by Mr. A. G. Cooper.

Institution of Electrical Engineers (Glasgow Section).—Tuesday, February 8th. At 8 p.m. At 207, Bath Street, Glasgow. Paper on "Equitable Charges for Tramway Supply," by Mr. H. E. Yerbury.

Saturday, February 12th. At 7.30 p.m. At the Grosvenor. Annual smoking concert.

National Electrical Manufacturers' Association (Inc.).—Tuesday, February 8th. At 2.30 p.m. Committee meeting.

Association of Engineers-in-Charge.—Wednesday, February 9th. At 8 p.m. At St. Bride's Institute, E.C. Paper on "Modern Arc Lamps and their Application," by Mr. A. Angold.

Institution of Electrical Engineers (London).—Thursday, February 10th. At 8 p.m. At the Institution of Civil Engineers. Paper on "Losses of Transmission Lines due to Brush Discharge, with Special Reference to the case of Direct Currents," by Mr. E. A. Watson.

Physical Society.—Friday, February 11th. At 8 p.m. At the Imperial College of Science, South Kensington, S.W. Annual general meeting; Presidential address.

Royal Institution.—Friday, February 11th. At 9 p.m. Discourse on "Electrical Properties of Sand," by Mr. C. E. S. Phillips.

Saturday, February 12th. At 3 p.m. Lecture on "Electric Waves and the Electromagnetic Theory of Light," by Prof. Sir J. J. Thomson (Lecture I).

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

The following orders are issued:—

Commanding Officer—Col. R. E. B. Crompton, C.B.

Monday, February 7th.—"A" Company. Technical drill, 7 to 9.30 p.m.; recruits' infantry drill, 6 to 7 p.m.

Tuesday, February 8th.—"B" Company. Technical drill, 7 to 9.30 p.m.

Wednesday, February 9th.—Gymnasium, 6.30 to 9.30 p.m.

Thursday, February 10th.—"C" Company. Technical drill, 7 to 9.30 p.m.

Friday, February 11th.—"D" Company. Technical drill, 7 to 8.45 p.m.; infantry drill, 8.45 to 9.45 p.m.

Saturday, February 12th.—"D" Company. Week-end run at Coalhouse Fort. Parade at Fenchurch Street Station, 3.15 p.m. Dress: Service dress with putties, greatcoat and haversack.

(Signed) P. H. Campbell, Capt. R.E. and Adjutant.
For O.C. E.E., L.D.

NOTES.

Tramway Socials.—About 120 members and friends of the Blackpool and Fleetwood Tramroad Co.'s Sick Benefit Club held a social on Friday evening last.

The Dundee Corporation tramway men held their annual reunion on Wednesday last week. Mr. Alex. Spence, convener of the Tramways Committee, who presided, complimented the officials and all connected with the tramways on the city's singular immunity from serious accident.

Fatality.—At the electric lighting company's works at Galway last week, an employé named George Stevens was killed. From the evidence adduced at the inquest it appeared that Stevens, who was 19, in company with his brother, was sweeping out the machine and turbine houses. The deceased was inside the "rope drive," and was caught in the ropes and whirled into the wheels, and was killed instantly. Death resulted from a wound in the right groin, which was ripped open for 10 or 12 in. The inquiry was adjourned in order that the Board of Trade Inspector might be present.

Private Bills in Parliament.—It has been decided that the following Bills shall in the forthcoming Session originate in the House of Lords:—Baker Street and Waterloo Railway, Bishops Stortford, Harlow and Epping Gas and Electricity, Cavehill and Whitewell Tramways, Charing Cross, Euston and Hampstead Railway, Farnham Gas and Electricity, Handsworth U.D.C., Leeds Corporation, London Electric Railway Amalgamation, London United Tramways, Mersey Railway, Met. District Railway, Met. Railway, Morecambe Tramways, North-East London Railway, Nottingham Corporation, Reading and District Electric Supply, Wimbledon and Sutton Railway, and Yorkshire Electric Power.

Electrical Football League.—The clubs forming this League now stand as follows:—

	Matches decided.	Goals For.	Goals Against.	Points.
City of London Electric	5	9	2	10
Metropolitan Electric	5	15	7	8
St. James' Electric	6	19	17	6
Robertson & Oram	3	6	9	2
County of London Electric	4	8	14	4
General Electric	5	2	10	—

The M.E.A. Glasgow Meeting.—The five senior Magistrates, the City Treasurer and two members of the Finance Committee have been appointed by the T.C. to confer with the Tramways and Electricity Committees, and make the necessary arrangements for extending a civic welcome to the members of the Incorporated Municipal Electrical Association on the occasion of the annual convention of that body in Glasgow in June of this year.

South African Electrical Engineers.—At Johannesburgh recently Mr. J. R. Bradley presided over a large attendance at the first annual meeting of the South African Institute of Electrical Engineers. Mr. F. Rowlands read the report of the Provisional Committee, which showed that in response to circulars sent to all ascertainable addresses of electrical engineers in South Africa, 158 applications for membership had been received. The Committee had endeavoured to keep the status at a high standard, and they had elected 71 members, 65 associate members, 14 associates and 8 students. This was a very satisfactory beginning. A draft constitution and rules were put before the meeting and adopted. The ballot for the officers and Council to hold office until January, 1911, resulted as follows:—President: Mr. C. W. R. Campbell. Vice-presidents: Mr. W. Elsdon-Dew, M.I.E.E, and Mr. M. Rohman. Members of Council: Messrs. T. J. Armstrong, F. W. Bentley, W. C. Brown, E. Crowther, W. H. Perrow, Dr. M. Schwabach, W. Sutton, G. A. Webb and L. B. Woodworth (members), and E. D. Brunner, C. W. Lowe, and J. S. Ross (associate members).

Mr. Campbell, in taking the chair, thanked the members for the honour accorded him, and stated that he would do his utmost to promote the interests of the Institute and of the profession generally. Mr. Elsdon-Dew also expressed his thanks, and stated that he considered that such an Institute had been very much needed for a long time past.

The meeting closed with a hearty vote of thanks to the Provisional Committee, and particularly to Mr. J. R. Bradley, for their work, which had resulted in the successful inauguration of the new Institute.

Institution and Lecture Notes.—Junior Institution of Engineers.—With the permission of the chief engineer to the Westminster Electric Supply Corporation, Sir A. B. W. Kennedy, F.R.S., a large number of members recently visited the Corporation's new generating station. This station has been built to replace the old Millbank Street station, which must be pulled down in consequence of the County Council's scheme for making an embankment roadway from the House of Commons towards Chelsea. The County Council has provided the company with a new site in Horseferry Road, and is bearing the expense of rebuilding the station and filling it with plant to an extent equivalent to the present capacity of the old Millbank Street station. The actual size of the Horseferry station and the amount of plant being put in are greater than at Millbank Street, and this additional size and amount of plant is, of course, being paid for by the company. The buildings, as at present completed, can ultimately hold 6,600 kw. of steam turbine-driven plant generating direct current at 440 volts. They can also ultimately contain about 14,000 kw. of motor-generator plant, the motors working with three-phase current at 6,600 volts, supplied from the joint station belonging to the Westminster Electric Supply Corporation and the St. James's Co. at Grove Road, transforming this to direct current at about 440 volts for supplying the Westminster district. The plant at present erected, or being erected, is as follows:—Four water-tube boilers, each with its own economiser and superheater, capable of producing 25,000 lb. of steam per hour at 260 lb. pressure with 150° superheat; two 300-kw. turbines, each driving two 150-kw. generators placed tandem, these being the balancer sets; three 1,000-kw. turbines, each driving two 500-kw. generators placed tandem; separate surface condensers with air pumps for each turbine, and a special arrangement of circulating water pumps, including strainer boxes and rotary strainers for sucking water from the Thames, forcing it through the condensers and back to the river; direct-current switchboards for controlling the turbine-driven generators, and for controlling the d.c. feeders; a 2,000-ampere-hour battery with 200 cells in all, arranged across the three-wire system; two battery boosters, the boosters being regulated by hand; one 500-kw. motor arranged with two 250-kw. generators for balancing, and two 1,000-kw. motor-generators, each with single 1,000-kw. d.c. machines (the three-phase motors of these motor-generators are all of the asynchronous type with slip rings and resistances for starting up); complete high and low-tension switchboard for controlling the motor-generator plant; electrically-driven travelling cranes in turbine house and motor-generator room; coal-conveying machinery, ash hoist and gear, and coal-measuring boxes between the bunkers and the boilers.

At a recent meeting of this Institution, a paper on "The Design and Running of Modern Cement Works" was read by Mr. Harry Horsburgh. The largest kiln in this country is that of Messrs. Edgar Allen & Co., of Sheffield, 150 ft. long, installed at Messrs. Forder's Cement Works at Sundon. As a sequel to the paper, a large party of members afterwards visited Messrs. Forder's Works.

Tramways and Light Railways Association.—The annual general meeting will be held on Friday, February 18th, at 7 p.m., at the Gaiety Restaurant, followed by the annual dinner and smoking concert at 7.30.

Institution of Mining Electrical Engineers.—At the meeting of the South Wales branch on Saturday last, the president, Mr. W. Maurice, read a paper on "The Causes and Means of Preventing Electrical Accidents in Mines."

Institute of Metals.—The annual meeting and conference of the Institute was opened on January 18th at the Institution of Mechanical Engineers. Sir W. H. White moved the adoption of

the report, which showed that the membership had increased from 355 to 505, and the finances were in a sound condition. Sir Gerard Muntz, the new president, afterwards took the chair and delivered an address. Papers were read and discussed on that and the following day, and the first annual dinner took place on the 18th.

Institution of Electrical Engineers (Leeds Section).—The annual dinner of this Section took place on the 28th inst. at the Hotel Metropole, Leeds, when close upon 100 members and guests sat down. The chair was occupied by Mr. W. M. Rogerson, of Halifax, and amongst those present were the Lord Mayor, Dr. Gisbert Kapp (President), Mr. Robert Hammond, Mr. A. G. Lupton, Ald. Matheson, Mr. John McLaren, Mr. P. Robinson, Mr. P. F. Rowell (secretary), and Mr. H. Dickinson, hon. secretary of the Leeds Section.

After the loyal toasts had been duly honoured, the toast of "The Corporation of Leeds" was proposed by Mr. Robert Hammond, who pointed out that Leeds's fortunes were, no doubt, due to its coal supply. Where coal was, the businesses of the world were centred. The Lord Mayor (Mr. W. Penrose-Green), in responding, said that Leeds was fortunate inasmuch as she had many industries. He referred to the efficiency of the Electric Lighting Department, under the chairmanship of Ald. Matheson, which was established in the early stages by Mr. Robert Hammond, and which had developed from a capital of £60,000 to something like a million. He would like the Committee to encourage the supply of electricity for power purposes, as he thought there was a great future before it. They had about 1½ millions of money sunk in the tramways, and it was very gratifying to know that they were worked at a profit, to the relief of the rates, and to the encouragement of trade. He thought that very shortly experiments would be made with a trackless trolley system, and thus in districts, where it would not pay to put down permanent way, they would be able to have a car service at much less cost to the city.

Mr. Councillor Herbert Brown submitted the toast of "The Institution of Electrical Engineers," and referred to the work of the Institution during the 40 years of its existence.

Dr. Gisbert Kapp, in reply, said the reason why electrical engineers were so numerous was because they were the handmaidens of every other engineering profession. The electric lighting station in Leeds was a model of good work and good design, while the tramway system was only second to that of Glasgow—a much bigger City.

The application of electricity to the heavy trades in the Leeds district had been considerably extended, but he was rather astonished that in a great textile district like Yorkshire he saw so very little of electric driving in textile mills. This he ascribed to a prejudice against electricity which resulted in people not getting to the bottom of any defect which might manifest itself when electrical driving was tried. They must remember that a long line of shafting took an enormous amount of power to drive, and resulted in a loss of anything from 20 to 40 per cent. of the power. About a year ago he was told by Prof. Barker, of the Bradford Technical College, that there were no electrically-driven mills in the Bradford district, but that a commission was investigating the subject. He thought it was rather late in the day to begin investigating, when the utility of electricity had been proved by every other country on the Continent. When the Professor told him that he was afraid the conclusion of the commission would not be in favour of electric driving, he was very much astonished. He considered that the electrical industry had been injured by the report of the commission which had been issued, and the public had received a wrong impression. No doubt the members of the commission had over-shot the mark. It was gratifying to know that the report was not one that electrical engineers would subscribe to; as a matter of fact, some of the member of the commission had refused to sign it. Wherever the report conceded that electric driving might occasionally do good, there were additional sentences put in to contend that the concession was one which could not be maintained throughout. With regard to one mill which the commission inspected, it was stated that the owner claimed an increased output because of the electric driving, but added that no actual evidence was obtained. If no evidence was obtained, how could the matter be proved? The only way to find out whether electric driving was an advantage was to take a mill driven by mechanical power and ascertain the conditions, and then electrify the mill and compare the results. It was said that electric driving offered the advantage of an easier check upon the power consumed, but it was added that where mechanical driving was employed the same thing could be obtained with a power meter. He asked if anyone knew of a power meter which could give anything like such accurate results and was so easy of application as an electric meter. The report again conceded that electric driving offered the advantage that it was easier thereby to run only a portion of the plant without serious loss in the transmission of power, but it added that where mechanical power was used the same advantage could be obtained by the judicious application of clutches. He contended that no amount of clutches would answer on a long line of shafting. He did not think it redounded to the credit of the industry that they in England should question the usefulness of electric driving. In one shop on the Continent he had seen hundreds of motors for the electric driving of cotton mills. There was one redeeming feature in the report—it was stated that the report was not to be regarded as complete or final, so that the door was not shut completely in the face of electric driving. He thought it would be to the benefit of the spinners and weavers if they introduced electric driving, and in this connection he thought the Leeds Local Section could do some useful work. He suggested that they should get a number of experts in the manufacture of spinning and weaving machinery, and also users, to form a Committee and call in the other side as expert witnesses, and decide the whole question. He had no fear of the verdict in that case.

Mr. A. G. Lupton proposed "The Leeds Local Section," and said he was glad to hear Dr. Kapp's criticism of the report on the electric driving of textile mills. Fortunately they were not all governed by that report, and he was glad to say they were hardly so far behind as the report alluded to would suggest. As one connected with the Yorkshire Electric Power Co., he might say that in 1908 more than half the company's revenue was derived from the textile trades. Textile manufacturers were very much alive to the benefits they enjoyed from electrically-driven machinery. The Chairman, in responding, mentioned that it would be the last time that they would meet under the name of the Leeds Local Section, for it had been decided that the name of the Section should be the "Yorkshire Local Section," and they hoped by that means to get increased attendances at their meetings. The Section had had bestowed upon it an honour of which it might be proud. The paper on "Equitable Charges for Tramway Supply," by Mr. Yerbury, had been read so far by two local sections, namely, Manchester Section and Leeds Section, as well as in London. They were also informed that the paper was to be read by the Glasgow and Birmingham Sections. He expressed the appreciation of the Section of the services of the hon. secretary (Mr. H. Dickinson). Alderman Matheson proposed "The Kindred Associations," and Mr. John McLaren responded. Mr. Walter Emmott proposed the toast of "Our Guests," and Mr. Percy Robinson replied.

The speeches were interspersed with selections by Mr. Wallace Hartley's orchestra, and humorous selections were contributed by Mr. S. H. Smith.

Electrical Trades Benevolent Institution.—From the list of the organising committee of this Institution's second festival dinner appearing in our last issue, the name of Mr. F. B. O. Hawes, A.M.I.C.E., of the National Electrical Manufacturers' Association, Incorporated, was omitted.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—On Monday evening, the 24th ult., an interesting gathering of employés took place at the works of the Brompton and Kensington Electricity Supply Co., when Mr. Henry W. Bowden, late manager and chief engineer, was presented with a silver inkstand, suitably engraved, together with an illuminated address. Speeches were made by Mr. R. S. Downe, general manager, and other members of the staff, touching upon Mr. Bowden's long connection with the company, viz., 18 years, and giving expression to the good wishes of all ranks. Mr. Bowden made suitable response, expressing his satisfaction, and said that, owing to his position as consulting engineer to the company, he would not be quite out of touch with his old employés.

The Manchester T.C. has been recommended to grant the following increases of salary in the electricity department:—Mr. J. A. Cookson, mains surveyor, from £350 to £375; Mr. W. E. Foden, accountant, from £375 to £400; Mr. F. E. Hughes, secretary, from £425 to £450; Mr. E. Bolton, sub-stations engineer, from £300 to £325.

On Thursday evening last week, Mr. W. A. Ritchie, resident engineer, Dumbarton Electricity Works, was presented with a gold watch and chain by the staff of the Electric Supply Corporation, Ltd., and friends, on the occasion of his resignation from the service of the company. He leaves to join the firm of W. R. Underhill & Co., electrical engineers and contractors, 79, Bath Street, Glasgow, the business of which firm is being formed into a private limited company, under the style of Underhill and Ritchie, Ltd.

At the Cape Town City Electric Light Works recently the works foreman, Mr. J. E. Langeveld, was presented with a tea service on the occasion of his marriage. The presentation was made by Mr. J. W. Stuart Clunas, the station superintendent.

On leaving Wolverhampton to take up an appointment as assistant electrical engineer with the Llandudno U.D.C., Mr. W. A. Jackson was presented with a writing cabinet by the officials and staffs of the electricity and destructor departments.

The Oldham T.C. has been recommended to increase the salary of Mr. S. W. Newington, borough electrical engineer, from £400 to £425 per annum, with a further increase of £25 at the end of a year.

Tramway Officials.—The Manchester T.C. has been recommended to increase the salary of Mr. J. M. M'Elroy, head of the tramways staff, from £1,000 by £50 a year, to a maximum of £1,250, Mr. M'Elroy agreeing to remain with the Corporation for five years. The salary of Mr. J. Wood, financial superintendent of the tramways, is also to be increased from £400 to £450.

At a dinner given by him to the Metropolitan Association of Electric Tramway Managers, of which he has become president, Sir Clifton Robinson on Wednesday announced that he retired that day from the management of the London United Tramways. His successor is Mr. Albert Stanley, general manager of the Bakerloo and other Underground Railways. It was stated by Sir Edgar Speyer that Sir Clifton was about to start for the Philippines, on a mission in connection with his firm.

General.—It is announced in the *Times* that Mr. Wilson Worsdell is retiring at the end of May from the position of chief mechanical engineer to the North-Eastern Railway. The directors have appointed him consulting mechanical engineer from that date. He will be succeeded by his present chief assistant, Mr. Vincent Litchfield Raven.

The Executive Committee of the National Physical Laboratory, on the nomination of the Advisory Committee for the National Experimental Tank, has appointed Mr. G. S. Baker to the post of Superintendent of the Tank, the funds for which have been provided by the generosity of Mr. A. F. Yarrow.

Mr. C. S. Northcote, M.I.E.E., desires us to mention that he is in no way connected, directly or indirectly, with a firm of electrical manufacturers trading as Messrs. Northcote, Heaver & Co.

Obituary.—Prof. Kohlrausch.—The death of Prof. Friedrich Kohlrausch, F.R.S., at the age of 70, deprives us of another of the great pioneers of electrical science; he was best known in electrical circles, probably, by his investigations in connection with electrolytes.

Mr. A. D. Smith.—The death took place on January 28th of Mr. Arthur Denby Smith, director of the Keighley Electrical Engineering Co., Ltd. He was 40 years of age.

Mr. F. E. Exley.—Mr. Francis E. Exley, from 1873 to 1903 superintendent of the postal telegraph department at Nottingham, and formerly assistant superintendent at Hull, died on Saturday. He was from 1853 until 1870 with the Electric and International Telegraph Co.

Mr. C. K. North.—The death occurred suddenly on Saturday of Mr. Charles K. North, who was for 12 years manager of the Rossendale Valley Tramways Co. He was 46 years of age.

Sir Charles Todd.—We regret to record the death, which occurred a few days ago, of Sir Charles Todd, K.C.M.G., who was for a long period of years Postmaster-General and Superintendent of Telegraphs for South Australia. Sir Charles was born in London (Islington) in 1826, and after some years' service at Greenwich and Cambridge Observatories, he accepted, in 1855, the appointment by the Colonial Office, of Superintendent of Telegraphs and Government Astronomer in South Australia. The *Standard*, in a brief summary of his wonderful record as a telegraphic pioneer in that part of the world, says that one of his first projects in his new post was the connection of Melbourne and Adelaide by telegraph, which was effected by 1858. He next addressed himself to the completion of a direct line between Adelaide and Sydney. His great achievement, however, was the construction of the trans-Continental telegraph line, an important link connecting the Old World and the New. The South Australian Parliament authorised the undertaking in 1870, and on August 22nd, 1872, communication was established between Adelaide and Port Darwin. For half a century Sir Charles Todd was Superintendent of Telegraphs in South Australia, and from 1870 to 1905 he was also Postmaster-General. In the latter year he retired.

CITY NOTES.

Anglo-American Telegraph Co., Ltd.

The directors report that the total receipts from July 1st to December 31st, 1909, including the balance of £24,414 brought forward from the last account, amounted to £240,993. The traffic receipts show an increase of £12,391, as compared with the half-year ended December 31st, 1908. The working expenses of the half-year, as shown by the revenue account, amounted to £80,349, being an increase of £1,312, as compared with the corresponding period of 1908. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £10,000 to the renewal fund, leaving a balance of £150,644. Quarterly interim dividends of 15s per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, were paid on November 1st last, absorbing £52,500, leaving a balance of £98,144, out of which the directors recommend the proprietors to declare final dividends of £1 7s. 6d. per cent. on the ordinary stock, £1 10s. per cent. on the preferred stock, and £1 5s. per cent. on the deferred stock, payable on February 5th, amounting together to £96,250, making a total distribution for the year ended December 31st, 1909, of £3 12s. 6d. per cent. on the ordinary stock, £6 per cent. on the preferred stock, and £1 5s. per cent. on the deferred stock. The balance of £1,894 will be carried forward.

National Gas Engine Co., Ltd.

The directors, in their report for the year ended December 31st, 1909, state that the net profit, after providing amply for depreciation of buildings, tools, &c., and allowing for management, salaries and income-tax, is £41,682. An interim dividend for the six months to June 30th, amounting to £18,089, being at the rate of 5½ per cent. per annum on the preference shares and 20 per cent. per annum on the ordinary shares, was paid on July 31st, 1909, leaving a balance of £23,563, which, added to £14,360 brought forward from last year, makes a total of £37,952 to be dealt with. The directors recommend the payment of a final dividend at the rate of 5½ per cent. per annum on the preference shares and 20 per cent. per annum on the ordinary shares, both less income-tax, for the six months ended December 31st, 1909. This will absorb £18,009, and leave £19,943, of which the directors propose to place £10,000 to the reserve fund (making it £100,000), and to carry forward £9,943.

The board have issued the following circular to the shareholders:—

From the experience of your directors, they are convinced that a large business is to be done in the manufacture of gas engines of powers considerably in excess of those they have already been able to offer on the market. They have therefore decided to erect a suitable works for the special purpose of manufacturing large engines up to 3,000 H.P. Your directors have been able to acquire a plot of land of about 20 acres adjoining these works on advantageous terms. Plans and specifications have been prepared by the company's architect, and contracts entered into with the builders and constructors, so that the erection of the works is well in progress, and, it is expected, will be completed by May next. In order to meet this extra expenditure (which will amount to about £50,000 in buildings and plant) and to provide the extra working capital necessary for the increased business, the directors have decided to issue the balance of the authorised capital, viz., 50,000 preference shares and 50,000 ordinary shares.

These will be offered at par to the present shareholders as follows:—One new preference share for every three preference shares, and one new ordinary share for every three ordinary shares.

Electrical Trade in the U.S. in 1909.—According to the *Electrical World*, the revival in trade during the past year was very marked. The General Electric Co.'s business averaged about £1,000,000 per month throughout the year, and the percentage of profits will be better than in 1908. The prospects for the current year are regarded as exceedingly bright. The output of the Allis-Chalmers Co. increased month by month, and at the close of the year was equal to 80 per cent. of the capacity of the plant, which is put at £6,000,000 per annum. The Western Electric Co. did a gross business of about £9,000,000 during the year, a figure which has only been exceeded twice in the company's history. The Westinghouse Co. is doing £500,000 per month, and the year's total will be at least 85 per cent. of the best on record. All these companies refer to the scarcity of orders for heavy machinery, a large proportion of the trade having consisted of small apparatus; and all of them are anticipating very good business this year. An editorial estimate places the total production of apparatus and income from service at 300 million pounds sterling

Yorkshire (West Riding) Electric Tramways Co., Ltd.—The report states that the operations of the year to December 31st, after providing for all expenses, including repairs and renewals, resulted in a net income of £26,808. Adding the balance brought forward, £13,661, the available profit is £40,469. This profit has been dealt with as follows:—Debenture interest (less income-tax) on 4½ per cent. stock, £11,678; debenture interest (less income-tax) on 6 per cent. bonds, £1,274; sundry reserves as per appropriation account, £8,362; reserve against Lofthouse Park, Ltd., debentures and shares, £9,500; carried forward, £9,654. The number of passengers carried during the past year amounted to 8,817,229, and the miles run to 1,771,635, as against 9,056,132 and 1,803,015 respectively for the previous year.

Prospectus.—*Rim (Malacca) Rubber Estates, Ltd.*—This company has been offering for subscription at par 50,000 shares of £1 each.

Provincial Tramways Co., Ltd.—The directors have issued a circular proposing a writing down of the assets by £124,560 by converting the £10 ordinary shares (now quoted at £4 10s.) into five shares of £1 each.

Dundee, Broughty Ferry and District Tramways.—An interim dividend of 6 per cent. per annum has been declared on the preference shares.

Anglo-Malay Rubber Co.—This company has announced a third interim dividend of 25 per cent. (6d. per share).

National Boiler and General Insurance Co.—An interim dividend of 6s. per share is announced.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

Rangoon Electric Tramway and Supply.—Further issue of £14,948 4½ per cent. first mortgage debenture stock.

Vickers, Sons and Maxim.—Further issue of 39,500 ordinary shares of £1 each, fully paid, Nos. 3,533,715 to 3,562,500, and 3,662,501 to 3,678,214.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the five weeks ended December 31st were 598,714 compared with 483,259 units in the corresponding five weeks of 1908.

National Telephone Co.—Dividends are announced at the rate of 6 per cent. per annum on the preferred and deferred stocks, less tax, carrying £170,000 to reserve and about £11,000 forward.

St. James' and Pall Mall Electric Light Co., Ltd.—The directors recommend a balance dividend on the 7 per cent. preference shares for the half-year ending December 31st, 1909, of 3s. 6d. per share, and 5s. per share on the ordinary shares, making with the interim dividend paid thereon a total distribution of 10 per cent. Last year the ordinary dividend was at the same rate.

Central Electric Supply Co., Ltd.—The directors have declared a dividend of 5 per cent. (5s. per share) on the ordinary shares for the year to December 31st.

City and South London Railway Co.—The half-yearly meeting was held on Tuesday, and the report of the directors was adopted. Our account of the proceedings will appear next week.

MARKET QUOTATIONS.

Wednesday, February 2nd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	„	28/-	..
a „ Sulphuric	„	5/6	..
a Ammoniac, Sal	„	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	..
a „ „	„	£30	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16	..
a Ferro-Silicon (50 %)	„	£10 10	..
a Copper Sulphate	„	£19	..
a Lead, Nitrate	„	£27	..
a „ White Sugar	„	£23 10	..
a „ Peroxide	„	£82	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3¼d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a „ Chlorate	per lb.	3½d.	..
a „ Perchlorate	„	3½d.	..
a Potassium, Cyanide	„	7d.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70 %) ..	„	£11	..
a „ Chlorate	per lb.	3¾d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
a „ Cyanide (basis 100 %) ..	„	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£75	..
b „ Wire, in ton lots ..	„	£112	..
b „ Sheet, in ton lots ..	„	£120	..
p Babbitt's metal ingots	„	£38 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	7½d.	..
c „ Tube (brazed)	„	9½d.	..
c „ „ (solid drawn) ..	„	7¾d.	..
c „ Wire, basis	„	6¾d.	..
c Copper Tubes (brazed)	„	9½d.	½d. inc.
c „ „ (solid drawn ..	„	9½d.	½d. inc.
g „ Bars (best selected) ..	per ton	£74	£1 dec.
g „ Sheet	„	£74	£1 dec.
g „ Rod	„	£74	£1 dec.
e „ (Electrolytic) Bars ..	„	£64	..
e „ „ Sheets ..	„	£80	..
e „ „ Rod	„	£88 10	..
e „ „ H.C. Wire	per lb.	8¾d.	..
f Ebonite Rod	„	3/3	..
f „ Sheet	„	3/-	..
a German Silver Wire	„	1/6	..
h Gutta-percha, fine	„	5/6 to 6/6	..
h India-rubber, Para fine	„	7/8	..
l Iron Pig (Cleveland warrants) ..	per ton	51/9	3d. dec.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Ingot	„	£18 15 to £18 17 6	dec.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£9 10	3/- dec.
d Mica (in original cases) small ..	per lb.	6d. to 1s.	..
d „ „ „ medium	„	2/6 to 4/-	..
d „ „ „ large ..	„	4/6 to 8/6	..
p Phosphor Bronze, plain castings	„	11½d.	..
p „ „ rolled bars & rods	„	1/3	..
p „ „ rolled strip & sheet	„	1/3	..
o Platinum	per oz.	120/-	variable.
e Silicium Bronze Wire	per lb.	9½d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£146 to £147	..
n „ Wire, Nos. 1 to 16	per lb.	1/9½	..
p White Anti-friction Metals:—			
"Ibis" brand	per ton	£45 to £150	..
k Zinc, Sh't (Vieille Montagne bnd.)	„	£27 10	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd
p London Phosphor Copper & Bronze Co., Ltd.
r W. F. Dennis & Co.

Great Northern and City Railway Co.—The report for the half-year ended December 31st, 1909, states that the total revenue receipts for the six months amounted to £37,909, and the cost of working to £20,605, being at the rate of 54·35 per cent. The net revenue amounts to £17,304, which is insufficient to meet the company's fixed charges for the half-year, but the sum of £5,709, which has been provided from outside sources, has made up the difference. The number of passengers for the six months under review, including season ticket holders, was 5,652,556, as against 5,533,697 for the corresponding period last year. The number of local season tickets issued during the half-year was 2,917, as against 3,178 for the half-year ended December 31st, 1908. The number of three-route season ticket holders using the company's line during the past half-year was 2,302, as against 2,200 for the corresponding half-year. The directors, after careful consideration, have, with great reluctance, felt themselves compelled to abandon the hope of constructing the extension to Lothbury, in view of the financial position of the company and its present restricted traffic. It is not, therefore, intended to proceed with the Bill for an extension of time which is now before Parliament.

STOCKS AND SHARES.

Tuesday Afternoon.

The roar and din of the General Election having been happily silenced, Stock Exchange markets and business generally are able to return to more normal conditions. So far as the markets are concerned, the political strife is hardly far enough away at present to be forgotten as a factor, so activity wakes but slowly. Only amongst Rubber shares is there any real excitement.

And in them it must be said that there is sufficient wildness to make up for a lot of stolid indifference on the part of prices elsewhere. The boom goes on merrily, with checks very occasional and fleeting. A huge speculative account has been built up by this time, and in this lies the great source of weakness, which must become apparent immediately profit-taking on any noticeable scale sets in.

The unanimous question demands to know how soon the boom will come to an end. Were the problem connected merely with the price of the product, it might be reasonably replied that another six, or even 12 months' run could be expected, with sundry setbacks. But with an extended bull account so patently existent, and with prices being whirled up at a lightning pace, it is thought by many that some cold douche must come before long.

The terrible plight of Paris at the end of last week appears to have rather unnerved certain holders of London tube stocks, the prices of which are decidedly weak. Central Londons again have given way, and the market is depressed beyond what might be deemed the natural result of the dividend and report. All three issues have suffered. City and South London also drooped. Districts fell ¼, Metropolitans 1, of which half was due to *ex* dividend marking.

The luckless Great Northern and City Railway has once more to rely upon extraneous assistance for the full payment of interest on its prior charge stocks. In the report the directors abandon the idea of extending the line into Lothbury, and no doubt this step was forced upon them by the utterly hopeless prospect of being able to raise the necessary capital.

London United Tramways 4 per cent. Debenture stock has risen 2. British Electric Traction First Debenture continues to improve. Calcutta Tramways Preference shares have been in some demand, but the Anglo-Argentine group is a trifle easier. Mexico Trams have dwindled, though the bonds are better. Rio Trams at 96 are 1½ to the good, following up their advance of last week, and the company's First Mortgage bonds hardened to 96½. There is, however, more business doing in the 5 per cent. 50-year mortgage bonds, which stand at 87½, and are being bought by investors prepared to take a little risk in return for a good yield on their money. Coupons are due on May 1st and October 1st.

Quietly, and yet sensationally, the Common shares of the Northern Light and Power Company have shot up from 30 to 77 within the space of the last week or two. The concern operates at Dawson City, in the Yukon district. It would seem that there is a struggle for control going on between the English concern and an American syndicate, which wants to step in, and whose presence the people in possession are not disposed to welcome. In this case also there are 5 per cent. bonds, the price being about 86.

Mexican Electric Light Co. bonds are firmer at 82, buyers being attracted by the return of 6 per cent. obtainable, although there are authorities in the market who think that preferable securities are to be had. Mexican Light and Power issues have improved to the extent of a point.

The St. James' and Pall Mall Company has declared its regular dividend of 5s. on the Ordinary shares, the price of which is unaltered. Charing Cross Ordinary have been sold by people who are exchanging into the company's City Undertaking Preference, so a fall of 2s. 6d. in the first is balanced by a gain of similar amount in the second. Newcastle-on-Tyne have further rallied, and there is a small gain to be noted in South Metropolitan Ordinary. Edmundson's Debenture at 61½ displays another rise, this time of 3 points.

Investment shows a striking partiality for telegraph and telephone descriptions, with the result that gains outnumber losses by 6 to 1; it is difficult to refrain from adding how many this counts on a division. The Anglo-American Telegraph report was read as satisfactory in the market, but this did not save the price of the Deferred declining. However, Cuba Telegraphs are better, and so are Eastern Extensions, Western Telegraphs, Indo-Europeans, Globe Preference and a few prior-charge stocks. A creditable report from the National Telephone Company caused no movement in prices, but Chile Telephones are stronger, and United River Plates of both classes. American Telephone and Telegraph capital stock fell 1; New York Telephone 4½ per cents. hardened to 100¼, *ex* the 7s. 6d. per cent. allowed for one month's interest carried by the scrip, in addition to the six months' coupon on the bonds.

The feature of the manufacturing list is a spirited rise of ⅞ in Babcock & Wilcox, for which the expected Naval Programme is primarily responsible, armament shares also being firm. British Insulated rose 5s. Edison & Swan "A" shares shrank 1s. 3d., reducing the price to perilously near freezing-out point. A security that is coming into rather more prominence is the 6 per cent. Prior Lien bond of the British Westinghouse Company; the price is 99, and the interest payments are due on May 1st and October 1st.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations Jan. 25th.	Closing Quotations Feb. 1st.	Business done week ended Feb. 1st, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3⅜ — 3⅞	3⅜ — 3⅞	..	..	..	Nil.
136,702	Do. do. 5 % Debs., Nos. 1 to 1,350 Red.	100	5 %	5 %	5 %	5 %	99 —102	99 — 102	..	..	..	4 18 0
$121,551,400	American Telephone & Telegraph, Cap. Stock	$100	8 %	8 %	8 %	8 %	141 —143	140 —142	..	..	—1	5 12 8
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	94 — 96	94 — 96	..	..	..	4 3 4
553,460	Anglo-American Telegraph	Stock	33%	33%	£3 4s.	33%	60½ — 62½	60½ — 62½	..	..	..	5 16 0
3,220,770	Do. do. do. 5 % Pref.	Stock	6 %	6 %	6 %	6 %	100½—101½	100½—101½	101½	100½	..	5 17 11
3,220,770	Do. do. do. Deferred	Stock	1⅝ %	1 %	8/-	25/-	21⅛ — 21⅝	21 — 21½	21½	21	— ⅜	5 17 8
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	..	101 —103	101 —103	..	..	..	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	7⅞ — 8	7⅛ — 8⅛	..	..	+ ⅛	4 17 9
2,431,850	Commercial Cable, Sting. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	86 — 88	86 — 88	87½	..	..	4 10 11
16,000	Cuba Telegraph	10	5 %	6 %	6 %	..	8⅜ — 9⅛	8⅛ — 9½	..	..	+ ⅛	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	17 — 18	17 — 18	17⅛	..	..	5 11 1
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3 — 3½	3 — 3½	..	..	..	5 14 8
5,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	..	8 — 8½	8 — 8½	..	..	..	6 5 0
50,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99 —101	100 —102	..	..	+1	4 8 8
60,710	Direct United States Cable	20	4½%	4½%	4½%	..	13⅜ — 14½	13⅜ — 14½	14	..	..	5 19 1
89,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,366, R.	100	4½%	4½%	4½%	4½%	98½—100½	99 —101	..	..	+ ½	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	133 —136	133 —136	134½	134	..	5 2 11
2,000,000	Do. 5½ % Pref. Stock	100	5½%	5½%	5½%	5½%	85 — 87	85 — 87	85½	85½	..	4 1 5
1,996,705	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..	4 16 11
300,000	Eastern Extension, Australasia, and China Tels	10	7 %	7 %	7 %	..	12½ — 12⅝	12½ — 12⅝	12⅝	12⅝	+ ⅛	5 9 10
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102½—104½	101 —103 xd	101	..	..	3 17 8
200,000‡	East. & S. Afric. Tel., 4 % Mt Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 8
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	..	10⅜ — 10⅞	10⅜ — 10⅞	10½	10⅜	..	5 6 1
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13⅛ — 13⅜	13⅛ — 13⅜	13⅜	13⅛	+ ⅛	4 6 6
150,000	Great Northern Telegraph, of Copenhagen	10	20 %	20 %	18 %	..	29½ — 30½	29½ — 30½	29⅝	..	..	5 16 2
5,000‡	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	98½—100½	99 —101	..	..	+ ½	4 9 1
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	..	50½ — 52½	51 — 53	..	..	+ ½	6 2 8
$41,980,400	Mackay Companies Common	$100	5½%	4 %	4 %	4½%	93 — 95	91 — 93	..	..	—2	4 11 3
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	78 — 83	78 — 83	..	..	..	4 16 5
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	2⅛ — 2⅜	2⅛ — 2⅜	14/-	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	6 8 0
86,492	Do. do. do. 6 % Pref.	1	6 %	6 %	6 %	..	⅞ — 1	1 — 1⅛	..	..	..	5 6 8
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107 —108½	107 —108½	107⅞	107½	..	5 10 7
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	123 —125	123 —125	124½	123½	..	4 16 0
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10½ — 11½	10½ — 11½	..	..	..	5 6 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10⅛ — 11	10½ — 11	..	..	..	5 9 1
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅞ — 5⅛	5⅞ — 5⅛	5⅛	..	..	4 7 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 — 100	98¾	..	..	3 10 0
1,988,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	99 —101	99½—101½	100½	100½	+ ½	3 19 8
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	8 %	8 %	..	1⅜ — 1½	1⅜ — 1½	..	..	..	5 5 9
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	4 14 9
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..	4 10 11
99,400	Pacific & European Tel., 4 % Guar. Debr., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
11,889	Reuter's	8	6 %	6 %	6 %	..	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	4 18 9
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
3,042	Submarine Cables Trust	Cert.	6 %	6 %	6 %	..	129 —132	129 —132	..	..	..	4 7 5
120,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅞ — 7⅛	7 — 7½	..	..	+ ⅛	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	4⅜ — 4	4⅜ — 5	..	..	+ ⅛	5 0 0
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	3 1d 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13⅜ — 14½	13⅜ — 14½	14⅛	13⅜	+ ⅛	4 18 3
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —103	101 —103	102½	101½	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	2⅛ — 2⅝	2⅛ — 2⅝	..	..	..	Nil
84,568	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	..	8⅝ — 9⅛	8⅝ — 9⅛	..	..	..	6 11 6
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	..	8 — 9	8 — 9	..	..	..	6 13 4
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 — 102	100½—102½	..	..	+ ½	4 17 7

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5 % Cum. 1st Pref., 1 to 640,000	5	..	..	..	..	4⅞ — 4¹⅛	4⅞ — 4¹⅛	92/6	88/9	..	5 6 1
500,000	Do. 5 % 2nd Pref., 800,001 to 1,800,000	5	..	..	..	..	4⅞ — 4⅞	4⅛ — 4⅜	88/9	..	— 1/8	5 14 3
978,230	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	90½ — 92	90 — 91½	91½	90½	— ½	4 7 5
332,387	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
630,000	Babcock & Wilcox, 1 to 630,000	1	20 %	20 %	20 %	..	4⅜ — 4⅝	4⅛ — 5⅛	101/3	95/-	+ 5/8	5 19 2
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1⅞ — 1⅞	1⅞ — 1⅞	..	..	..	3 19 2
60,000	British Aluminium, Ord., 1 to 40,000	6	7 %	7 %	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	Nil
60,000	Do. do. 7 % Cum. Pref.	6	7 %	7 %	3½%	..	1⅛ — 1⅜	1⅛ — 1⅜	30/-	..	..	10 0 0
40,100	Do. do. "A" 6 % Cum. Pref.	6	6 %	6 %	6 %	..	3⅛ — 3⅜	3⅛ — 3⅜	..	..	..	8 5 6
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	2 %	..	3¼ — 3⅜	3¼ — 3⅜	..	..	..	5 11 1
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	5½%	5½%	5½%	5½%	97 —100	95 — 98 xd	..	..	..	5 12 8
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	8 %	8 %	8 %	8 %	141 —145	141 —145	143	141	..	5 10 4
400,000	Do. Pref. Ord. Stock	100	6 %	6 %	6 %	6 %	121 —125	116 —116 xd	122½	117	..	5 0 0
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	108 —111	108 —111	110½	..	..	4 10 1
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
188,801	British Electric Traction	10	Nil	Nil	Nil	..	1⅛ — 1⅜	1⅛ — 1⅜	20/4½	..	..	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1½%	..	3½ — 4	3½ — 4	74/9	73/1½	..	3 15 0
1,478,652	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	88 — 91	89 — 92	90¾	90½	+1	5 8 8
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	..	67 — 71	67 — 71	..	..	..	6 6 7
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	..	7⅛ — 7⅜	7⅛ — 7⅜	7⅜	7⅛	+ ⅛	6 9 0
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	6⅛ — 6⅜	6⅛ — 6⅜	..	..	+ ⅛	4 10 7
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	..	103 —106	103 —106	..	..	..	4 4 11
904,940‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	89 — 94	89 — 94	..	..	..	4 15 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	..	⅛ — ¾	⅛ — ¾	..	..	..	Nil
1,816,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	..	47 — 51	47 — 51	..	..	..	7 16 10
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	¹⅞ — 2⅛	¹⅞ — 2⅛	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	..	41 — 46	41 — 46	..	..	..	9 15 8
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	..	25 — 29	25 — 29	..	..	..	15 3 0
187,610	Calcutta Trams, 1 to 187,610	5	8 %	6 %	4½%	..	4½ — 5	4½ — 5	92/6	90/-	..	4 10 0
45,804	Do. 5 % Cum. Pref., Nos. 1 to 29,380..	5	5 %	5 %	5 %	..	4½ — 4⅝	4½ — 5	..	..	+ ⅛	5 0 0
850,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	99 —102	99 —102	101	..	..	4 8 3
85,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	..	10 — 10⅜	10 — 10⅜	10⅜	..	..	6 19 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5⅛	..	4 10 11
900,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102½—104½	102½—104½	..	..	..	4 6 2
491,229	Cape E. Trams., 1 to 491,229	1	Nil	Nil	Nil	..	⅛ — ⅛	⅛ — ⅛	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	..	2⅜ — 2½	2⅜ — 2½	49/9	..	..	5 0 0
210,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	105 —108	103 —106 xd	..	..	..	4 4 11
1,890 690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	55 — 57	54 — 56	56½	55	—1	4 10 11
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	86 — 88	85 — 87	86½	..	—1	4 3 4
554,655	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	48 — 50	46 — 48	..	..	—2	5 6 1
1,480,000	City and South London Railway	Stock	3½%	3½%	1½%	1⅜%	33½ — 33⅝	32 — 33	33½	32	— ⅛	5 4 6
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	5 %	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11

* Unless otherwise stated, all shares are fully paid.

‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909	Closing Quotations Jan. 25th.	Closing Quotations Feb. 1st.	Business done week ended Feb. 1st, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
250,000	Dick, Kerr & Co., 1 to 250,000	1	10 %	10 %	6 %	..	1 — 1⅛	1 — 1⅛	..	..	..	6 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1⅛ — 1⅛	1⅛ — 1⅛	21/6	..	..	5 9 1
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
60,000	Dublin United Trams. (1899), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	..	12⅜ — 13⅜	12⅜ — 13⅜	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½%	2½%	Nil	..	⅛ — ⅜	⅛ — ⅜	..	..	— 1/32	Nil
117,139	Do. "A" shares, £1—£17,139	5	4½%	2½%	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
807,896	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	64 — 69	64 — 69	..	..	..	5 15 11
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	..	81 — 84	81 — 84	..	..	..	5 19 1
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	1/32 — 1/16	1/32 — 1/16	..	..	..	Nil
81,850	Do. do. 7 % Cum. Pref., 1 to 81,850..	2	7 %	7 %	7 %	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	10 4 0
75,000	General Electric Co. (1900), 5 % Cum. Pref. ..	10	5 %	5 %	5 %	..	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	6 1 3
2 0,000	Do. do 4 % Mort Deb.. ..	Stock	4 %	4 %	4 %	..	83 — 87	83 — 87	..	..	..	4 12 0
75,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 75,000	10	4 %	¾%	Nil	..	3/32 — 1/16	3/32 — 1/16	16/-	..	..	Nil
96,000	Greenwood & Bailey, 7 % Cum. Pref.	10	7 %	7 %	..	..	10¼ — 10½	10¼ — 10½	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 —103½	102 — 103	..	..	..	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	5 %	15%	15 %	..	12 — 12⅜	12 — 12⅜	12 1/16	..	..	5 17 8
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5 — 5⅛	5 — 5⅛	..	..	..	4 3 9
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	..	104 —106	104 —106	105½	..	..	4 4 11
50,000	India-Rubber, Gutta-percha & Telegraph Works..	10	0 %	10 %	10 %	10 %	15 — 15½	15 — 16½	..	..	..	6 7 0
97,500	†Liverpool Overhead Railway, Ord.	10	Nil	¾%	Nil	Nil	1/16 — 1/16	1/16 — 1/16	..	..	..	Nil
10,000	† Do. do. Pref., fully paid ..	10	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..	10 0 0
600,070	London United Trams. (1901), 1 to 50,007	10	3 %	3 %	Nil	..	1½ — 2½	1½ — 2½	..	..	..	Nil
999,980	Do. do. 50,008 to 100,000	10	3 %	3 %	Nil	..	1½ — 2½	1½ — 2½	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	32½	..	1⅜ — 2⅜	1⅜ — 2⅜	40/-	..	..	16 15 10
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock ..	100	4 %	..	4 %	4 %	60 — 65	62 — 67	64	63½	+2	5 19 5
5,782,062	Metropolitan Consolidated	100	1 %	½%	½%	1 %	39½ — 39⅝	38½ — 38⅝ xd	39½	38 1/16	..	2 10 4
2,640,914	Do. Surplus Lands	100	2½%	2½%	2½%	2½ %	67 — 69	66 — 68	66⅝	..	—1	4 0 11
3,285,000	Do. District	100	Nil	Nil	Nil	Nil	18 — 18½	17⅞ — 18⅛	18⅛	17⅞	— ⅛	Nil
291,337	Metropolitan Electric Trams., Ord.	1	..	..	4½%	..	11/32 — 3/16	11/32 — 3/16	12/6	..	..	6 10 11
314,016	Do. do. Defd..	1	Nil	Nil	Nil	..	3/32 — 1/8	3/32 — 1/8	1/-	..	..	Nil
600,000	Do. do. 5 % Cum. Pref. ..	1	5 %	5 %	5 %	..	7/32 — 1/4	7/32 — 1/4	16/6	..	..	5 14 3
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	92 — 95	92 — 95	93½	..	..	4 14 9
$10,923,200	Mexico Trams Co., Common Stock	..	..	..	..	..	130½ —132½	128 —130	130	128½	—2½	..
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	5 %	..	92 — 94	94½ — 96½	96½	95½	+2½	5 3 8
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	1/32 — 1/16	1/32 — 1/16	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	3/32 — 1/8	3/32 — 1/8	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	84 — 87	84 — 87	..	..	..	5 3 6
87,350	Telegraph Construction and Maintenance	12	15 %	17½%	15 %	..	34½ — 36	34½ — 36	35½	..	..	5 3 0
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99 —101	99½ —101½	..	..	+ ½	3 18 10
1,000,000	Underground Electric Railway, 5% Prior Lien ..	..	..	..	5 %	..	101 —102	101 —102	101	..	..	4 18 0
2,800,000	Do. do. 4½% Bonds	..	..	..	4½%	..	87 — 89	87 — 89	87½	87⅜	..	5 1 2
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	33 — 35	33 — 35	33¾	33¼	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	10 %	5 %	..	1/32 — 1/16	1/32 — 1/16	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 126,001 to 141,666	6	..	6 %	6 %	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	2 8 4
245,495	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	..	72 — 77	72 — 77	..	..	..	5 1 3

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5⅛%	5⅛%	5⅛%	..	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	5 15 9
70,000	Do. do. 4½ % 1st. deb. stock ..	100	4½%	4½%	4½%	..	91 — 94	91 — 94	..	..	..	4 18 9
80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	10 %	..	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	6 1 8
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	4 4 10
400,000	Central Electric Supply 4 % Guar. Deb. Stock ..	100	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply ..	5	5 %	5 %	5 %	..	4 — 4⅛	3⅞ — 4⅛	88/11½	80/7½	— ⅛	5 14 3
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4⅛ — 4⅜	4⅛ — 4⅜	85/-	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	3⅞ — 4	3⅞ — 4⅛	80/-	..	+ ⅛	4 17 0
445,786	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
49,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	4½%	2½ — 3⅜	3⅛ — 3⅜	..	..	..	6 0 0
175,000	Do. do. 4½ % Deb. Stock Red. ..	Stock	4½%	4½%	4½%	..	98 —101	99 —101	..	..	..	4 9 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	..	10½ — 10⅝	10½ — 10⅝	..	..	..	5 11 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	12 — 13	12 — 13	..	..	..	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	120 —124	120 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	..	..	1⅞ — 2	1⅞ — 2	..	..	..	5 0 0
50,000	Do. do. do. 5 % Pref. ..	5	5 %	5 %	5 %	..	2⅛ — 3⅜	2⅛ — 3⅜	..	..	..	7 8 2
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	91 — 93	91 — 93	..	..	..	5 7 6
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅛ — 8	7⅛ — 8	..	..	..	6 5 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	10⅜ — 11⅛	10⅜ — 11⅛	..	..	..	5 7 10
400,000	Do. do. 4½ % Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
400,000	Do. do. 4½ % 2nd. Deb. Stock ..	Stock	4½%	4½%	4½%	..	98 —101	98 —101	100½	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares ..	5	Nil	Nil	Nil	..	1/32 — 1/16	1/32 — 1/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	5	3 %	Nil	Nil	..	1/32 — 1/16	1/32 — 1/16	..	..	..	Nil
400,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	..	57 — 60	60 — 63	62½	..	+3	7 2 10
$8,150,000	Electrical Dev.Co.of Ontario, 6% 1stMtg.Gold Bnds.	$500	..	..	5 %	5 %	81 — 84	81 — 84	82	..	..	5 19 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	..	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	..	4⅛ — 5⅜	4⅛ — 5⅜	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 - 100	95 — 98	..	..	—2	4 11 10
15,000	Hove, 1 to 15,000	5	9 %	8½%	8½%	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 13 4
$1,976,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	102 —104	102½—104½	103½	103½	+ ½	4 15 8
21,000	Kensington and Knightsbridge Electric Ord. ..	5	10 %	10 %	8 %	..	7 — 7⅛	7 — 7⅛	..	..	..	5 4 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	94½ — 96½ xd	95½	..	..	4 2 11
111,000	London Electric Supply Corporation, Limited, Ord.	8	4 %	2½%	3 %	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	4 4 3
70,000	Do. do. do. 6 % Pref. ..	5	6 %	6 %	6 %	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	6 0 0
882,855	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½%	4½%	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
800,000	Metropolitan Electric Supply, 1 to 100,000	5	5 %	6½%	5 %	..	4 — 4⅛	4 — 4⅛	85/-	82/6	..	5 11 1
75,131	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	..	4⅜ — 5	4⅜ — 5	95/-	..	..	4 10 0
235,000	Do. 4½ % 1st Mort. Deben. Stock ..	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
248,000	Do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½%	3½%	3½%	3½%	83 — 86	83 — 86	..	..	..	4 1 5
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	..	80 — 82	81 — 83	82	..	+1	6 0 6
18,586,000	Do. Light and Power Co., Ltd., Common ..	$100	..	..	3½%	..	67 — 69	68 — 70	68½	68½	+1	5 0 0
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	..	100 —104	101 —105	107½	101¼	+1	6 13 4
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	..	5 %	5 %	88 — 90	88 — 90	90½	..	..	5 11 1
960,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..	4 11 10
180,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	2½%	..	3⅞ — 4⅛	4 — 4⅛	89/4½	..	+ ⅛	2 15 9
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	..	4⅛ — 4⅜	4 — 4⅛	..	..	— ⅛	5 11 1
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	5 %	99 — 101	99 —101	..	..	..	4 19 0
16,852	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	12⅛ — 13⅛	12⅛ — 13⅛	..	..	..	5 6 0
20,000	Oxford, 1 to 96 and 407 to 20,816	5	7 %	7 %	..	..	6 — 6⅛	6 — 6⅛	6⅛	6⅛	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	..	93 — 96	93 — 96	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507 ..	1	2½%	6 %	8 %	..	1⅛ — 1⅜	1⅛ — 1⅜	30/7½	..	..	4 18 6
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	..	1 3/32 — 1 5/32	1 3/32 — 1 5/32	22/6	..	..	5 19 0
200,000	Do. do. 6% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
40,000	St. James' and Pall Mall Electric Light, Ord. ..	5	10 %	10 %	10 %	10 %	8¾ — 9	8¾ — 9	..	..	..	6 7 0
80,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 7⅛	7 — 7⅛	..	..	..	5 11 1
150,000	Do. do. 3½ % Deb. Stock Red. ..	100	3½%	3½%	3½%	3½%	86 — 87	86 — 87	..	..	..	4 0 6
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	2 — 2⅛	2 — 2⅛	..	..	..	Nil
95,000	South London Electric Supply, Ord.	4	8 %	4 %	5 %	..	2⅞ — 3⅛	2⅞ — 3⅛	61/3	..	..	9 6 1
120,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	..	100 —103	100 —103	..	..	..	..
130,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	..	1/32 — 1/16	1/32 — 1/16	..	..	..	4 8 11
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	..	1⅛ — 1⅜	1⅛ — 1⅜	23/6	..	+ 1/32	5 15 6
224,592	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	..	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	3/32 — 1/8	3/32 — 1/8	..	..	..	25 6 8
60,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1¼ — 1½	1¼ — 1½	..	..	..	14 5 4
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	..	74½ — 78½	74½ — 78½	..	..	..	5 14 8
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000 ..	1	..	..	5 %	..	1/32 — 1/16	1/32 — 1/16	..	..	..	5 6 8
100,000	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	8⅝ — 9⅛	8⅝ — 9⅛	..	..	..	5 9 7
51,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 3 9

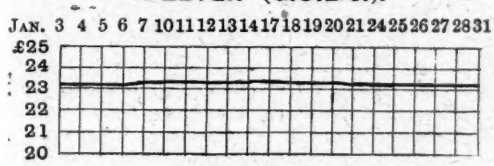
* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 3½% per cent., January 19th, 1910.

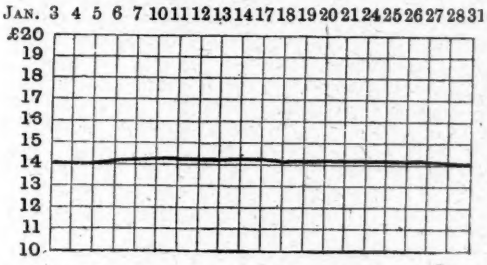
METAL MARKET.

Fluctuations in January.

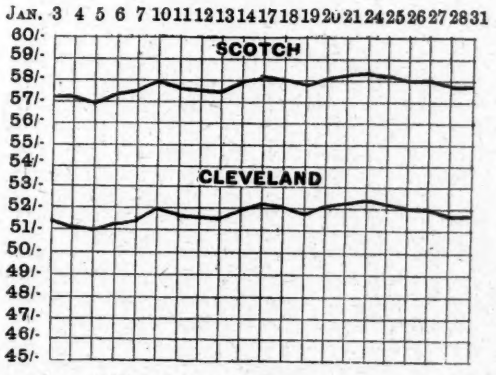
SPELTER (G.O.B's.).



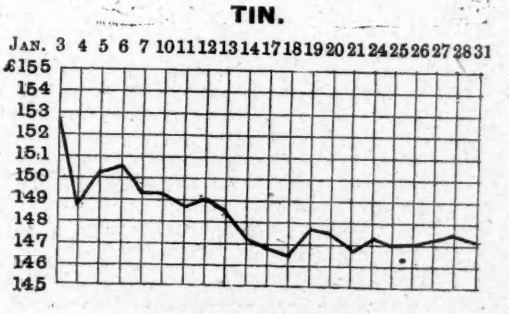
LEAD (ENGLISH).



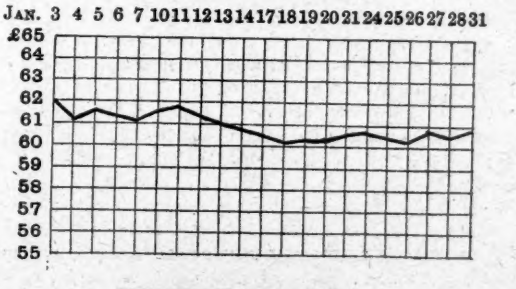
IRON.



TIN.



COPPER (G.M.B's.).



Dundee Electricity Works.—It was resolved by the Electricity Department of the Dundee Town Council at a recent meeting, that all future building constructional work in connection with that department be carried out by the city electrical engineer.

NOTES ON TRAMWAY OVERHEAD EQUIPMENT.

By H. DUDGEON.

(*Continued from page* 157.)

If none of the cross spans acted as "anchors," the stress in the trolley wire would be practically the same throughout its length, and the same strain would, of course, be borne by any splicing ears, frogs and section insulators on the line. Terminal and frog anchors—if the frogs were anchored as they should be—would have the same strain at least to bear, but might have considerably more. Section insulators and frogs and crossings should be rigid enough in their vertical sections to stand the strain without their centres bending downwards, or "bellying" as it is called. This is a common fault with these fittings, and is conducive to bad running.

As well-worn No. 0 trolley wire has been found sufficiently strong for its purpose, there is no reason why 0000 should be scrapped before it has worn to the same cross-sectional area, if there is no objection from the electrical point of view. But this would only be advisable where the wire had worn uniformly throughout its length and the tension had been thereby correspondingly reduced. If it has gone thin at the ends of the ears only, then the original tension remains and the factor of safety is reduced.

The difference in dip due to changes in temperature is rather difficult to estimate owing to the trolley wire being elastic to a certain extent. The law governing this property in a wire states that—within a certain limit—the tension of a wire varies directly as its extension beyond its natural length. This is usually expressed :—

$$S = M \frac{l_1 - l}{l},$$

Where l_1 = length of wire when stretched, l = length before stretching, S = stress in wire when stretched, M = modulus of elasticity.

The quantity M depends on the material from which the wire is made ; for hard-drawn copper it is 18,000,000 lb. per sq. in. Examination of this equation will show that M is the force per sq. in. that would stretch a wire to twice its natural length, if it were possible, or is 1,000 times the force required to stretch it $\frac{1}{1000}$th of its length, and so on ; 120 ft. of 0000 trolley wire suspended with 9 in. dip has a tension of 1,161 lb. By the above law the wire will have stretched about 0·7 in., and if it were possible to remove this tension the wire would return to its natural length. Consider then the case when the temperature rises. The wire will undergo an increase in length $l\ t\ k$, where k is the coefficient of expansion and t is the temperature rise. Owing to the expansion there will be a tendency for an increase in dip which will, therefore, give rise to a decrease in tension. This decrease in tension will thus cause a contraction in the length of the wire compensating partly for the expansion. The resultant increase in length will, therefore, be due to the difference in the two effects, and is given by—

$$\Delta l_1 = l_1\ t\ k - l_1 \frac{\text{change in tension}}{A\ M},$$

$$= l_1 \left(t\ k - \frac{S_1 - S}{A\ M} \right).$$

Solving the equation for t, and neglecting the very small error in assuming the true length of the wire to be equal to the horizontal length, we can write—

$$t = \frac{\Delta l_1 + l \left(\frac{S_1 - S}{A\ M} \right)}{l\ k},$$

where l_1 = length of wire in span, l = horizontal length of span, S_1 = original tension, S = altered tension, M = modulus of elasticity, A = cross-sectional area of wire, k = coefficient of expansion, t = degrees F. change of temperature,

By means of this equation, and those already given, there are several ways of working out practical results, but they are necessarily rather tedious operations. One way is to assign a value to s, work out the corresponding value of Δl_1 and then find the temperature difference necessary to produce this difference in tension; t will be positive or negative as Δl_1 is positive or negative. The coefficient of expansion of copper is ·00000955 per degree F.

The following table shows the changes in the dip and strain produced by change in temperature of 120 ft. span of trolley wire, with 9 in. dip at 60° F. It will be noticed that a falling temperature does not alter the dip to the same extent as a rising one :—

Dip in inches.		5	6	7	8	9	10	11	12	13	14
Tension in lb.	4/0	2,090	1 741	1,493	1 306	1,161	1,045	950	871	804	746
	3/0	1,805	1,504	1,290	1,128	1,003	903	821	752	694	645
	2/0	1,580	1 317	1,129	988	878	790	718	658	608	564
	1/0	1 370	1,141	978	856	761	685	623	571	527	489
Degrees F.		10	27	40	51	60	68	75	82	88	95

This change due to temperature is a subject about which most practical overhead workers have a hazy idea, and many of the printed formulæ on the subject are erroneous, as they do not take into account the stretching of the wire. It is interesting to note in this connection that a contractor when measuring up trolley wire allows and charges so much extra owing to the dip, usually about 6 yards per ½-mile section. In reality, for ½ mile of 40-yard spans with 9 in. dip, the difference between the horizontal and the actual length of the wire is 0·55 ft., and subtracting the amount the wire has stretched, the net or natural length of the wire is about 7 in. less than ½ mile.

To come back to trolley troubles. Under ordinary circumstances, junctions and curves provide most. Taking a simple curve, the faults giving rise to these troubles could be classified thus :—

1. Ears bent to too sharp an angle, owing to an insufficient number being erected, or those erected not being balanced up properly.
2. Badly designed ears.
3. Unsuitable single pull-offs.

Considering fault No. 1, the factors are too variable to allow of any satisfactory rules being formulated for governing the angles enclosed by the ears at curves. That there is a very definite limit to the speed with which a trolley wheel can safely traverse a bent ear is very natural, and if this limit is exceeded, or if the condition of the trolley gear of the car is below a certain standard of perfection, the result is that the wheel is de-wired. But there is another way of looking at this, viz., from the point of view of economy. It is common knowledge that the wire and ears at curves wear much faster than those on the straight. This excessive wear is the result of the side pressure of the trolley wheels, and it will be found greatest where the side travel of the trolley head is greatest, that is, where the ratio $\frac{\text{side travel of trolley head}}{\text{forward travel of trolley head}}$ is relatively large. This depends, of course, on the number of ears used for a given angle, and is greatest where the ears are fewest. To be too sparing, therefore, with the ears on a curve not only results in subsequent trolley troubles, but is very uneconomical in the long run. The same conclusion is arrived at if we consider that the force which tends to throw a trolley wheel off a badly bent ear is simply the reaction of the blow given to the ear by the wheel, and if 99 out of every 100 wheels safely negotiate it, it is only because they are hammering it with a somewhat less force than the remaining one. Long heavy ears that will not bend to a sharp angle in the centre will reduce this blow, and, therefore, the liability of the wheels to de-wiring, but they will not save the adjacent trolley wire from the hard wear due to bad alignment if the ears are too few in number.

For small-radius right-angled curves—up to, say, 50 ft.—seven ears give good results, and for larger radii, where greater speed is permissible, nine or more should be used. Fig. 1 is a plan of a double-suspension curve arranged with seven ears, and the dotted pull-offs at each end could be added if necessary.

When wiring a curve it is often forgotten that to keep the trolley pole central at the back of the car the wire should make a larger circle than the track. A trolley pole suddenly driving from its normal position through, perhaps, 45° to a new position, besides wearing the wire badly, is apt to entangle the hand rope with the destination signs, &c., and cause trouble. The exact position of the wire—especially with modern "easement" or spiral curves—would be rather difficult to estimate; but if a permanent-way plan is available, and it usually is, an easy way of finding the best position is to make, on the same scale as the plan, a cardboard template of the wheel base of a car and leave a pointed

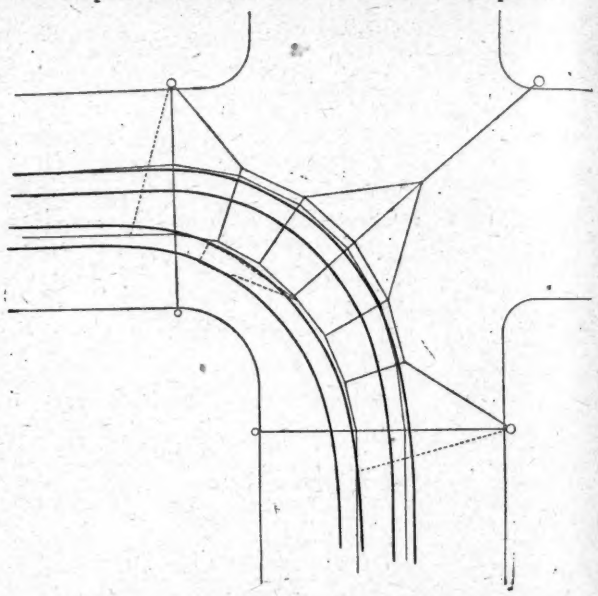


Fig. 1.

piece at one end to make up the horizontal distance to the trolley head. Such a template, if taken carefully round a curve on the plan, will show at once the ideal position of the wire. On fig. 1 is shown such a template.

With fault No. 2, although it is desirable to have the ears on a curve stronger than those on the straight, there is no advantage in going to extremes in the matter. Where the curves have been divided up properly, 12-in. ears weighing 1 lb. 6 oz. have been found quite satisfactory. The heavy "curve" ears commonly used have usually strong thick lips, which lead to hollows being worn in the wire at each end owing to the kicking of the trolley wheels at these points. To reduce the tendency for the ears at curves to bend sideways, the vertical height at the boss should be as small as possible, but care should be taken that the boss does not foul the most worn trolley wheels.

Fault No. 3.—When ordering fresh supplies of ears or single pull-offs—especially from different makers—the fact that they require to mate one another is often overlooked. The eyes of the pull-offs require to be in the same horizontal plane as the trolley wire, for if not, the ears will cant on their sides when erected. It is better even to have the centre of the eyes about ¼ in. below the centre of the trolley wire.

With regard to junctions, frogs are undoubtedly the worst offenders, and it would be pretty safe to assert that, on an average system, 50 per cent. of the total calls for the repair wagon are due either to frogs or to damage done by the trolleys leaving the line at them. In my opinion this is due entirely to the large angle these fittings are made to; 35°, 30°, 25° and 20° are the common sizes, 25° being the standard of most makers. A frog, at best, offers a worse path to the trolley wheels than an ear, and we would naturally anticipate trouble at, say, a right-angled curve where three ears only were used, each bent to 30°. The use of such large angles is, I believe, simply a survival of American practice introduced by the original contractors. In that country rigid trolley heads are commonly used, and what we term "trailing" frogs used as "leading" frogs. Such a practice would necessitate the use of wide angles,

and the placing of the frogs in a critical position on the junctions. But here, swivelling trolley heads are almost universal, and the leading frogs are nearly always controlled mechanically either by a pull-wire or an automatic drop lever. There is no necessity, therefore, for the use of wide-angled frogs, and to reduce trolley troubles substantially I would advocate that, except, perhaps, at car-sheds, no frogs above 15° be used, and a preference given to those nearer 10°. The position of the eyes for attaching the anchor wires to a frog is an important matter. They should be placed so that the frog, when erected, will not be twisted.

(To be concluded.)

PROCEEDINGS OF INSTITUTIONS.

Equitable Charges for Tramway Supply.

By H. E. Yerbury, Member.

(Abstract of paper read before the Institution of Electrical Engineers.*)*

In many cities and towns, tramway managers are agitating for a reduction in the price of traction units. The average price now charged to tramways departments by the 65 towns in Great Britain having combined lighting and tramway generating stations is 1·377d. per unit, the maximum price being about 2d. per unit, and minimum price 0·93d. per unit. Considering the low price now being charged by electric supply departments for heating and general power purposes, it seems at first sight strange that a much higher price is invariably charged to tramway departments, notwithstanding the load factor and number of units per annum comparing very favourably with any commercial enterprise.

The price charged to tramway departments by authorities owning combined stations amounts to considerably more than the total costs in separate tramway power stations. In the generation of electricity we have what might be called primary and secondary costs. The primary costs depend only upon the maximum amount of energy that may be demanded at any time, and may be called "fixed costs." The secondary costs are dependent on the number of units generated, and may be called "running costs."

The former include interest and sinking fund, &c., on the total cost of generating station and plant which has to be installed for supplying the maximum demand, and may be said to remain fixed for any size of station, but these costs per unit generated diminish in proportion to the output of such station as shown in fig. 1.

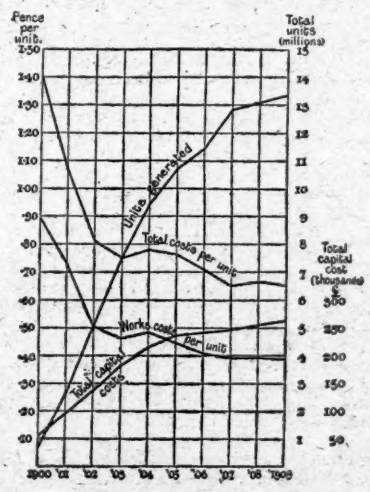

Pence per unit.
Total units (millions)
Units generated
Total costs per unit
Works costs per unit
Total capital costs
Total capital Cost (thousands) £
1900 '01 '02 '03 '04 '05 '06 '07 '08 1909

Fig. 1.

The latter are not entirely a constant value per unit generated, but depend on the fluctuating price of coal, &c., and also on the station load factor.

In order to allocate on an equitable basis to the lighting and tramway departments their respective proportions of the above costs, two all-important computations must be made:—

1. The maximum demand in kilowatts per annum required by tramway departments.

The maximum-demand principle is admittedly the fairest system of charging, and the majority of municipal supply tariffs are based on this system, whereby all consumers are supplied on the same terms, and the total costs are divided in the fairest possible manner.

2. The approximate kilowatt-hour consumption per annum.

From the above can be estimated the size of plant required (with reasonable spares), the standing charges of which will determine the principal item under "fixed costs," and the actual "running costs" can readily be arrived at when the kilowatt-hour requirements are known.

It must be admitted that there is a greater difficulty in arriving at an equitable "fixed charge" than in determining the selling price per kilowatt-hour based on a lump sum per annum independent of the number of units sold, plus running costs, with a reasonable percentage of profit to be agreed on. Whereas a lighting load lasts on an average, say, 3 hours per day, a tramway load demands a supply of energy for about 16 to 20 hours per day. It would be obviously unfair to charge a tramways department the same rate per unit as a large power consumer with the same maximum load, as in the former case you can have a long-hour demand and often in the latter case only an 8-hour per day or so demand.

It should be noted that although about 165 million units are sold annually by the supply authorities to tramway undertakings, at a higher rate than under their ordinary power supply tariff, the profit accruing from such business does not show very conspicuously in their respective annual statements of accounts, and the question may well be asked, Why is this? Are there some consumers who will only pay exactly the total cost price of generating electricity at the works? And are there also other large power consumers who can only be obtained by offering them a supply at less than the total cost price—*i.e.*, at approximately the price actually expended at the works per unit generated, ignoring all capital or standing charges? In the author's opinion, there is no doubt that agreements are drawn up and millions of units are actually sold under total cost price, but the engineers' claim is, that such business improves their station load factor! It would be equally true for such engineers to admit that a certain proportion of the total number of consumers were being charged considerably above total cost price, and that instead of each consumer bearing a fair and reasonable proportion of the cost incidental to the whole of the capital charges (if such be the policy), such charges are inflicted only on certain consumers, notably on tramway authorities. In other words, tramway departments have to bear costs which legitimately belong to the lighting and power departments.

It is manifestly equitable that the plant required to meet the maximum tramway demand at times of "peak load"—including spares—should be the measure taken for allocating the capital charges to a tramways department, but peak load in a tramway station may almost be said to be non-existent as compared to a lighting station.

The enormous fluctuations in load and strains and stresses which our American friends predicted at the inception of electric traction in England, are in practice unfounded, and consequently the costs in, say, keeping boilers under steam and for a "stand-by staff" for this theoretical "peak load" are infinitesimal; yet engineers of combined stations do not appear to look upon these cost as "running costs," but invariably include them under "fixed costs." Now, the fair proportion of these so-called "fixed costs" to actual "running costs" is a debatable point.

For general comparison between costs so determined by supply authorities and separate self-contained systems, actual figures are preferable to hypothetical estimates, and the two cities of Bradford and Sheffield may be taken as a fair comparison to show the basis of charge in the former case and the actual cost in the latter.

For the year ending March 31st, 1909, the Tramways Department of Bradford purchased 10,131,499 units at a cost of £47,384 11s. 8d., the price per unit being 1¼ 1. from the Corporation works and 1¾d. per unit from the Shipley Urban District Council. For the year ending March 25th, 1909, the Sheffield Tramways Department generated 18,373,958 units at a cost of £21,758 12s. 8d., excluding capital charges, and including all charges at a total cost of £36,765 14s. 9d., the works costs being at the rate of 0·390d. per unit, and total costs per unit = 0·659d., including maintenance of ducts and cables up to feeder pillars.

Under "fixed charges" we have for a low-tension tramway station of 4,450-kw. capacity:—

	Pence per unit generated.
1. Interest at 3·13 per cent. and sinking fund at 2·05 per cent.	0·241
2. Rent, rates, taxes and insurance	0·028
3. Depreciation and renewals based on 1·89 per cent. per annum on total capital expenditure. Proportion on power station, buildings, plant, cables, &c.	0·102
Total	0·371

It appears that about double the above total is generally considered directly chargeable to tramway departments by electric supply departments in determining the selling price per unit.

For instance, the Manchester Electric Supply Department in selling approximately 29½ million units to the Tramway Department for the year ended March 31st, 1908, in addition to the above usual items, also add items included in "running costs"—viz., coal, oil, waste, water, salaries and wages, repairs and maintenance of plant in the following proportions, viz.:—

Coal, 27·35 per cent. of amount included in "running costs" is also included in "fixed charges."
Oil, waste, water, &c., 27·35 per cent., ditto.
Salaries and wages, generating station, 100 per cent., ditto.
Repairs and maintenance of plant, &c., 33·33 per cent., ditto.

On a basis of 29½ million units per annum the "fixed charges" per unit sold are as follows:—

Coal	0·043
Oil, waste, water, &c.	0·004
Salaries and wages	0·069
Repairs	0·061
Rent, rates, taxes	0·087
Management, &c.	0·036
Interest and sinking fund	0·441
Renewals suspense account	0·121
Total	0·865

As this total of "fixed charges" alone amounts to more than the total generating costs in a separate generating station, it will be interesting to dissect the items in order to compare them with the average costs in a low-tension tramway power station.

1. *Coal.*—It is assumed by engineers of combined stations that a very considerable quantity of coal is burnt in keeping boilers under banked fires for "peak loads," and the expenditure under this head at Manchester amounts to 0·043d. per unit as a fixed charge. The author ventures to criticise the justice of this charge and to point out that about two million units could be generated in a tramway station with this estimated quantity of coal—assuming price to be approximately 10s. per ton—and it is usual for all coal consumed to be included in "running charges."

2. *Water, Oil and Waste, &c.*—This item also appears to be high, and amounts to about 0·004d. per unit as a fixed charge. In a tramway station generating about 14 million units per annum, this cost should be sufficient for all oil, waste, and other stores, even where reciprocating engines are in service, and in respect to water, the "fixed charge," if any, should be a very small one.

3. *Salaries and Wages.*—This item in the "fixed charges" under review amounts to 0·069d. per unit, and appears to be exceptionally high in view of the fact that under "management expenses" a further fixed charge of 0·036d. is allocated, making a total of 0·105d., which is considerably higher than the total charge under "management, salaries, and wages" in a low-tension tramway station.

Presumably in combined stations, under "management charges" are included administrative salaries and wages of clerks, meter inspectors, and others whose salaries and wages are not allocated to any special department. Here, again, the great difference between a tramway department and the general consumer is apparent. Meter readings are simple, and accounts for tramway departments are usually paid quarterly on one bill, but the author feels inclined to think from the above figures that tramway departments are being charged *pro rata* for management, &c., with ordinary customers, notwithstanding the fact that the latter require an elaborate book-keeping system, meter inspectors, and a large clerical staff.

Repairs and Maintenance.

The repairs to buildings, plant, mains, meters, &c., are estimated to be equal to 0·064d., which is about the same average per unit required to cover all repairs and maintenance to all steam and electrical plant, also power and sub-station buildings in a tramway power station, and including repairs to ducts, cables, &c., up to the feeder pillars, amounting to 0·016d., the total cost would be about 0·079d., so that a fixed charge of 0·064d. certainly appears to be on the safe side.

Rents, Rates and Taxes, &c.—The percentage of "fixed charges" under the above items debited to traction units is 37·12 per cent. of the total, which amounts to 0·087d. per unit. In the separate tramway station under review, the proportion of rates, taxes, and insurance on the entire station amounts to 0·028d. and including rates and taxes on cable ducts, cables, &c., to 0·056d. The apparently high former figure is doubtless accounted for by additional buildings and plant required for converting high-pressure current to the low-pressure tramway feeders, and possibly includes a proportion of the income-tax, although in the author's opinion this should appear only in the profit and loss account, and cannot very well be estimated when determining a selling basis or arriving at the cost of current production.

Interest and Sinking Fund.—An amount equal to 0·441d. per unit sold is computed in the combined station selling 29½ million units per annum and 0·241d. is the actual figure in the tramway power station generating about 13½ million units per annum. The great difference may be due to the provision of land, buildings, and plant, mains and feeders required for transforming high-tension alternating current to low-tension continuous current feeding the trolley wires.

Renewals, Suspense, or Depreciation.—The amount per unit which has been charged under this head in the combined station is 0·121d. or 1·63 per cent. per annum of capital expenditure. To bring into line a self-contained undertaking it may be assumed, as is done in Sheffield, that a sum equal to 0·75d. per car-mile is required to be set aside annually to build up a renewals fund or 1·89 per cent. per annum of total capital expenditure. The proportion of capital expenditure on the power station and all cables, &c., to that of the entire undertaking is 22·47 per cent. and spread over, say, 10 years, amounts to 0·102d. per unit, which estimate has proved so far to be sufficient for extraordinary renewals and obsolescence, as ordinary repairs and renewals are directly charged to power account.

Comparative Differences.

Having now dealt with a comparison between a combined and separate generating station, a few words should be said bearing on certain points which are not comparable in the two instances under review. In the first place, the comparison has been between a high-tension alternating-current station—principally—and a low-tension tramway station, and between units sold and units generated. These facts figure largely in the comparative data, for it is well known that where high-tension current is transformed and distributed, the total cost per kilowatt installed amounts to between £40 and £50, and at Manchester it amounts to about £61; whereas in a low-tension continuous-current supply the initial cost of all generating plant and freehold buildings need not be more than £35 per kilowatt, and including costs of all ducts, cables, &c., £50 to £55 per kilowatt, and in the former case the combined conversion and transmission losses and also running costs are considerably higher than from the latter supply. These are undoubtedly the factors which have a most important bearing on the subject of tramway tariffs, and which, in the author's opinion, often negative the benefit which should be received by a tramways department obtaining electrical energy from a combined general supply and traction works.

Whilst it must be admitted that with a continuous-current supply the area of the feeding zone from the generating station is limited, it should be borne in mind that in the majority of cities and boroughs, the length of tramway routes from the centre of city—or power station—to termini is not more than, say, 4 miles, in which case low-tension current can economically be transmitted, and where tramway authorities have a self-contained system there is no occasion to install high-tension plant under the above conditions consequently the capital charges are diminished and total costs present a favourable aspect when compared with cost of supply from a combined station.

It has been suggested by many tramway managers that under the same municipality the tramways department should not be charged a higher price per unit than the estimated total cost of production from a separate station.

This dictum appears reasonable, for there is no doubt that in a properly designed combined station, generating costs and total costs should be lower than in a separate station, but one finds that they are appreciably higher, and tramway departments fail to receive the expected benefit derived from combination.

Opinions differ as to the fairness of the policy or principle of dissociating the ordinary lighting and power plant with its high "service" charges from the tramway supply in computing a basis of charge, but it is well known that many engineers of supply undertakings in computing selling price per unit to large power consumers only charge such consumers the capital charges on plant and mains installed for such service, with the addition of running costs. This would, perhaps, be excusable if such a policy so reacted in lowering the cost of production that the lighting consumers had the benefit of a reduced tariff; but we often find that no such reduction takes place, and it remains to be seen whether the policy will eventually prove disastrous where a power supply predominates and the number of lighting consumers or the revenue obtained from the same diminishes. The author ventures to express the opinion that the above preferential treatment is justifiable where tramway departments are with a reasonable profit supplied from a combined station, for not only is the load factor known, but the all-important diversity factor can also be calculated and a bulk supply to tramways effects a general reduction in generating costs.

Summary.

Having dealt with the principal points affecting the determination of costs or selling price of electricity to tramway departments the suggestions for discussion may be summarised as follows:—

1. *Fixed or Capital Charges.*—To be based upon and calculated only on that portion of the undertaking which is essential for the actual generation and distribution of power to tramway departments.

2. *Management Charges.*—To be made up of salaries, insurance, rates and taxes, and, in certain cases, proportion of income-tax, as determined by the respective departments, all to be based on the kilowatt capacity of plant employed only for tramway supply.

3. *Running Charges.*—To be "works costs," made up of coal, water, oil and waste; salaries and wages of staff engaged in generation and distribution; also repairs and renewals of buildings, plant, ducts and cables. As the cost of coal averages from 50 to 55 per cent. of the total works costs, in basing a price per unit to a tramways departments, a clause should be inserted in all agreements extending over one year, whereby every shilling increase or decrease in cost per ton would mean a fraction of a penny per unit to be debited or credited to tramway departments.

It is not suggested that the "running costs" should be taken only on the plant employed for traction purposes, but on the entire station, as a tramway load reduces the cost of production, and the scale of charges should follow approximately the curve or line shown on fig. 1.

4. *Depreciation, Renewals and Obsolescence.*—The percentage suggested could be based either on units generated or sold or be calculated on capital expenditure on buildings, plant and mains required for tramway supply. Committees of various municipalities have directly opposite views as to an adequate depreciation fund, and the allowance made by the Income-Tax Commissioners in calculating income-tax upon municipal undertakings is often ignored. The financial policy adopted in Glasgow, for instance, cannot be followed by many towns. Still, it is regrettable to see the policy of some municipalities where the entire profits are put to relief of rates; needless to say, such action is disapproved by the officials concerned.

From the author's 14 years' experience in electric tramway work, a percentage of 1·75 per annum on the entire capital expenditure on buildings, plant, and cables should be considered a fair and reasonable allowance for depreciation and obsolescence.

5. *Profit from Tramway Departments.*—It is unreasonable to expect a combined station to supply current to a tramways department without profit, and it is suggested that from 3 to 5 per cent. profit should be charged only on the "running costs."

In conclusion, it should be mentioned that this paper is not dealing with the question of separate *versus* combined generating stations, neither is it an attempt to criticise or deprecate combined stations or to suggest what is best for a particular town or municipality as a whole, the object being to open up certain debatable points which materially affect the price per unit charged to tramway departments compared with actual costs in self-contained undertakings, the latter being invariably lower than the former.

The author gave particulars of the prices charged by local authorities, load factors, &c., in tables. Table I related to 65 combined traction and lighting stations; Table II, to 10 separate traction stations generating over two million units per annum; Tables III and IV, to certain cases differing somewhat from the former; Table V summarises the principal results of Tables I and II.

TABLE V.

Maximum, minimum, and mean prices in Tables I and II, and also for 17 systems in Table I, using over 2,000,000 units per annum.

Reference to table.	Pence per unit. Maximum.	Minimum.	Mean.
No. I. (*b*)	1·87	0·93	
(*c*)	2·00	1·04	1·3776
(*d*)	2·13	1·50	
No. II.	0·924	0·659	0·75653
17 of No. I.	1·78	0·99	1·225

(*b*) Power supply and capital charges on generating plant.
(*c*) Ditto, including charges on feeders.
(*d*) Only three cases including capital charges and maintenance of overhead equipment.

DISCUSSION.

The London discussion was opened by MR. J. F. C. SNELL, who objected to the author's suggestion that tramway departments were bearing costs which legitimately belonged to the lighting departments, although this might be true in some cases. It was difficult to compare the costs in different towns upon a common basis, and he thought much of the agitation was due to the different systems of analysis adopted in the case of lighting and tramway undertakings in the tables that form a feature of a certain contemporary, which prevented fair comparison. It was also a mistake to compare A.C. and D.C. installations, and he thought that in any comparison it was preferable to divide the A.C. systems into two classes, above and below 500 KW., and similarly the D.C. systems. As regards the tramway stations built under the Tramway Act, the period of loan repayment was fixed at 30 years, but in the case of combined stations the loan period had been gradually decreased to as little as 17 years in recent cases, and this increased the annual charges by as much as 2½ per cent. in some cases. It was true that some tramway departments allowed an amount for renewals, but this was not always done. It had to be remembered that one could not get quite the same benefit from plant which was used only for traction purposes as from plant used for both traction and general supply work. It was necessary to add a reasonable profit (say, 5 to 7½ per cent.) to cover risks in the case of a combined supply; the tramway load factor was a very variable one, ranging from 22 per cent. to 50 per cent., and 25 to 30 per cent. was a general figure. He thought Mr. Yerbury made a fundamental mistake in comparing the Sheffield D.C. installation with the Manchester system using A.C. and sub-stations; Glasgow might have been taken, although it was not strictly comparable. But the Glasgow accounts had to be adjusted, and the cost of energy came out at 1·2d. per unit, as compared with 1d. at Manchester. Although he came to the conclusion that separate tramway plants, averaging, say, 1½ million units per annum output, had an advantage, he thought there was not such a discrepancy as suggested between the respective figures. The municipal idea was to combine because it was then possible to put in larger units and obtain increased economy with less gross expenditure on the part of the municipality. In some cases tramways were paying more than if they had their own plants, but generally the charges were equitable, and as the electric supply grew, the tramway would be in a better position to obtain a cheaper supply than from its own plant. Mr. Snell suggested that the equitable method of assessing the charges to tramways from a combined station was to take the maximum demand of the tramways at any time, also the KW. demand at the time of the maximum demand on the whole of the plant. The equitable amount on which the tramways should pay was the mean of these two figures. The first was a measure of the electrical plant required for tramway purposes, and the latter of the steam-raising plant, so it was fair to equate these two values. Taking the fixed charges—the interest and sinking fund on the capital cost of the power station and sub-station, if any (but not the mains), the cost of management (excluding the distribution department), rents, rates, taxes, and insurance, and wages at power station; dividing this amount by the total demand on the station for all purposes, they got a figure per KW. demand. This amount, multiplied by the mean KW. demand for tramways as obtained above, represented the annual standing charges to be paid by the tramways department. To obtain the running costs, take the sum of the coal, stores and repairs in power and sub-stations, and divide by the units generated, less the units used for internal purposes in the station. This figure and the actual units metered at the power house (or with three-phase transmission, at the sub-station switchboard) represented the sum to be paid annually by the tramways. This, added to the standing charges above, represented the total cost of production *qua* tramways. He usually advised a further figure of 5 per cent. or 7½ per cent. on the above cost of production as a fair commercial addition to cover variation in price of coal, risks of fire, explosion, increased assessment, renewals and obsolescence, and also a small profit. It was also well to have a biennial revision on these lines.

MR. STUART RUSSELL joined issue on the subject of the division of fixed and running costs. He considered that the running cost should be proportional to the units generated, and that the fixed charge should include a percentage for fuel, oil, water, &c., as appeared to be the case at Manchester. He could not reconcile the various percentages of running charges mentioned in the case of Manchester, which the author stated were also found in fixed charges, with the price obtained for tramways energy in that city; he thought there must be some discrepancy in the figures. It seemed right in a combined plant to allocate capital charges between the two departments according to the use made of the plant, special plant being allocated to the user. Management, insurance, rates, &c., would be divided in the same proportion as capital. Salaries and wages could be included and divided as fixed charges, and he thought a proportion—say 25 per cent.—of coal, oil, water, &c., cost should also be included in fixed charges.

MR. E. COWAN said one could not dispute that charges as between one consumer and another should be equitable, but a higher price for locomotive purposes than for ordinary power purposes might be due to the value of power for that purpose being higher. Electrical engineers did not usually take into account this side of the question. The price of any commodity was determined by the law of supply and demand, but it was certainly influenced by quantity and production. It was impossible to ignore the element of demand, and the prices quoted to a tramway undertaking must be something better than it could obtain, say, on its own account. Different services had different market values, but electric suppliers tried to ignore this. Within the limits of practicability, the price should be fixed as nearly as possible at the market price of the service rendered.

MR. A. H. SHAW (Ilford) said he could not agree with the author's deductions, as taken from two large tramways, when nearly half the tramways took under one million units per annum. In a small station supplying an average of 12 cars, one small generating set was sufficient to supply the traction load, but the latter varied from nothing to 25 per cent. overload; this was an uneconomical load, and it resulted in greater wear and tear than in the case of plant used for general supply work. At Ilford they generally fixed the traction cost at the end of the year, at about cost, and this was 1¼d. per unit on 800,000 units per annum, with a 26 per cent. load factor. He had followed largely on the author's lines in finding this cost, taking only capital used for tramway purposes, but he had also averaged the running costs and thought this really benefited the tramways. There were one or two large power consumers at Ilford, with 20 to 25 per cent. load factors, who were supplied at 1d. per unit.

MR. O. H. WORDINGHAM said he had taken the view that the combined station was the correct thing, and he was really responsible for the arrangement at Manchester. The question depended on broad principles and on circumstances; a big tramway system and a small lighting system would give a different kind of result to the opposite combination. If both lighting and tramway undertakings were under one authority (say a municipality), it was no doubt better to have a combined plant; but if a company were operating the tramways it was a different question, as a good tramway load factor would be spoiled by a poor lighting load factor. At Manchester they adopted a fixed charge depending on the KW. used and a running charge. It was correct to include some coal cost in the fixed charge on account of radiation losses, &c. He could not agree that there should be any discrimination between the particular uses of energy, but one could discriminate in price according to quantity and kind of load.

MR. BOND said the subject interested him as a buyer of energy, and he thought a broad principle should be evolved as suggested by the author. Many municipal authorities supplied tramway companies with energy, and the price, fixed by agreement, was subject to arbitration and revised at intervals. In a case of this sort he thought the revision should be carried out on certain fixed principles, and he was prepared to accept a price based on the estimated cost of a separate station. He had not found any advantage in purchasing from a combined plant, and he was quite certain he could have saved money if he had been allowed to build his own traction supply plant. As to the profit which could be allowed a combined plant, he could not agree to 5 per cent., as the price was already debited with 3 per cent. over and above what a company would require; he would much rather have ½d. off the price per unit now than wait for the further reduction due to growth of the general supply.

MR. C. E. C. SHAWFIELD (Wolverhampton) thought the author had missed the point when he suggested that tramways should be charged on the same basis as the big consumer. In the Wolverhampton tramways the 25 cars usually out during the day were increased to 40 or 45 in the evening just when the peak load was on, from 4 p.m. to 6 p.m., and the load factor was not so good as was suggested. In the case of Wolverhampton, the station plant installed in 1901 cost about £100 per KW., as against the £35 mentioned by the author, and the steam consumption was much higher. In the turbine station recently erected the capital cost was only £20 per KW. and the steam consumption very low. To follow out the author's suggestion the early plant would have to be scrapped, and where did obsolescence come in? He thought it was obviously more costly to supply the tramways than his recent large power consumers.

MR. H. E. YERBURY, replying, said that he was strongly of opinion that tramway departments should not be burdened with capital charges incidental to the plant and high service charges connected with general supply departments, for it was well known

that ordinary services cost, say, £8 to £10, and large services amounted to nearly £20, so that, assuming there were 3,000 to 4,000 consumers, a capital expenditure of over £40,000 might be entailed, and it was unfair to expect tramway departments to pay the standing charges on this expenditure. According to the statement some years ago of the manager of the Manchester tramways, the standing charges per KW. debited to the tramways amounted to nearly £12 (nearly 1d. per unit), whereas in self-contained systems, say, Leeds and Glasgow, with their high-tension plant, they amounted to £4 1s. 3d. and £3 5s. 5d. respectively, which equalled ·40d. per unit on the D.C. traction side. Assuming that fixed charges were based only on plant required for tramway supply, there was no reason why a combined undertaking should not supply energy to tramway departments at the same price as the latter could generate at, and this should leave a fair margin of profit. If, on the other hand, the fixed charges incidental to the entire undertaking were debited to the tramways in proportion to their requirements in KW., then he had no hesitation in saying the tramways would be more economically run as entirely self-contained undertakings. It was well known that in H.T. stations, losses in transmission and conversion were far greater than in L.T. stations. At Sheffield the standing charges per unit generated were 289d., and on the basis of units taken by cars, ·295d. At Manchester, however, which was a combined station, the standing charges amounted to ·503 l. per unit generated, *i.e.*, total output of the station. They knew theoretically that the total costs should be very much lower in a combined station than in a separate station, but in practice this was found not to be so, and the tables in the paper showed that the costs were very much higher. He had endeavoured to differentiate between different sized stations by only including those generating above two million units per annum. He disagreed with Mr. Snell that there was a greater charge to municipalities where two stations where built, as rates had been relieved to a far greater extent by self-contained tramway undertakings. Mr. Snell's suggestions as to a fair basis for charging appeared to be a great improvement on existing methods of computation. In reply to Mr. S. Russell, whilst he agreed that radiation losses were a fixed charge on a station, the total quantity of coal consumed covered all losses, and should be chargeable to works costs. If not, why were not ordinary power consumers charged also with this so-called fixed cost? In respect to the criticism of certain figures mentioned in the paper, the only Manchester figures available were for 1907-8, whereas the figures for Sheffield and those in the tables were for 1909. In reply to Mr. Cowan, although there might be a higher market value for current used for certain purposes, he thought electricity was the same, no matter what use was made of it. In reply to Mr. Shaw, it was admitted that there were far more violent fluctuations in small tramway systems, hence the same were not compared with those specifically dealt with in the paper. As regarded coal consumption, speaking generally, it should be lower on a tramway load factor of 26 per cent. than on a power load of 20 per cent. to 25 per cent., but the hours of supply were, of course, an important factor. Mr. Wordingham had spoken more from the standpoint of what was best for a municipality as a whole, but he, the speaker, did not deal with the question from the purely municipal standpoint, but principally from that of £ s. d. He quite agreed with Mr. Wordingham that there should be a saving by the acquisition of a tramway load to a combined undertaking, but if there was that saving it was not reflected in the price which was charged to the Tramways Department. He did not suggest in the paper that tramways should be charged at the same rate as power consumers, as he was strongly of opinion that power consumers were frequently being charged too low a price. In respect to standing charges of fuel and oil, &c., it was very difficult to estimate what this amounted to for different customers, and all should be included in works costs on which it was suggested that profits of 3 per cent. to 5 per cent. should be charged to tramway departments. In reply to Mr. Bond, he was quite right in assuming from a company standpoint that were a profit of only 3 per cent. charged on the total costs of production, this would be equal to 6 per cent. charge, as 3 per cent. was set aside for sinking fund. The author agreed that the total cost of production should not be more from a combined station than from a separate tramway station built by a company. If in Sheffield they had paid the same price per unit as, say, the Manchester or Bradford departments, or even 1d. per unit, there would have been nothing to hand over to relief of rates, and in some years a loss would have been entailed, whereas, during the past 10 years, the average relief of rates by the Sheffield tramways amounted to over £14,000 per annum. In regard to management charges, in a combined station these amounted to 30 per cent. or 35 per cent. of the total costs, as compared with 20 per cent. in separate tramway stations. In reply to Mr. Shawfield, it was, of course, admitted that modern stations could be equipped far cheaper than old-fashioned ones, and the question was whether it was just and fair to charge new consumers less than old consumers who had assisted in building up the undertaking. As to the question of depreciation and obsolescence, he was quite prepared to have his figure of 1·75 per cent. criticised, but it must be remembered that during, say, the first five years' life of undertakings, no money was required for renewals. On the system for which he was responsible, renewals on power station plant and cables during the past 10 years never amounted in any one year to more than approximately £1,000, and the average for the 10 years had been £450 per annum, so that on a capital expenditure of, say, £260,000 for plant and cables, 1·75 per cent., with the balance already in hand, would be ample for extraordinary renewals and obsolescence. In Sheffield they had an accumulated surplus and renewals fund amounting to over £92,000, or nearly 8 per cent. of the total gross expenditure of the undertaking, and he contended that present ratepayers should be relieved as much as possible, and that posterity should not be in the happy position of having a substantial balance at the bank in addition to a valuable asset in buildings, plant and cables at the expiration of the loan period.

The Faraday Society.

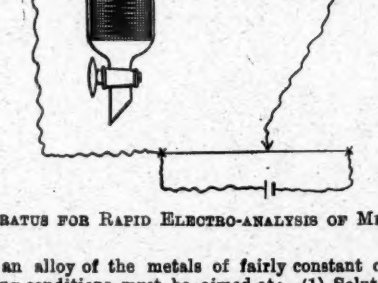
The society opened its Winter Session on January 18th, with four papers on the agenda.

The Electro-Deposition of Alloys.

Mr. S. Field is continuing his useful experimental studies on the conditions which determine the composition of electro-deposited alloys. A previous research dealt with the case of brass alloys; the present paper describes the attempts made to deposit silver-copper alloys. We say attempts, because although the closeness of the metals in the electrochemical series would lead one to suppose that the two could easily be deposited together from cyanide solutions, as a matter of fact, it is only between very narrow limits, indeed, that this appears to be possible.

The solution used by Mr. Field was that of the double cyanides of silver and copper with potassium cyanide, containing 25 grammes of each metal to the litre, or 1 equivalent of silver to 1·7 equivalents of copper. From this solution, practically pure silver was deposited at all current densities and at all temperatures. The solution was then diluted, insoluble anodes were used, the copper content was increased three or four-fold; considerable quantities of free cyanide were added to the bath, still practically pure silver was thrown down.

The next solution tried contained 1 gramme of silver and 20 grammes of copper to the litre, or 1 Ag : 34 Cu measured as equivalents. From this solution silver was first deposited alone, and it was not until the amount of silver was reduced to 0·4 gramme per litre that the metals were deposited together. Below this point, on the other hand, the percentage of copper deposited rapidly increased, hence



Apparatus for Rapid Electro-analysis of Metals.

to deposit an alloy of the metals of fairly constant composition the following conditions must be aimed at:—(1) Solution of large volume; (2) solution containing not more than 0·4 gramme silver per litre; (3) the silver to be replaced as rapidly as deposited. Under these conditions it was found possible to throw down a regular series of silver-copper deposits of the more positive metal, from one containing 0·25 per cent. copper with a P.D. of 1·55 volts to one containing 51·4 per cent. copper with a P.D. of 7·6 volts. The effect of adding free cyanide was to make it more difficult to deposit the two metals together (as is the case with brass), while temperature experiments showed more of the positive metal to be deposited at the lower temperatures.

In no cases was the quality of the compound deposit good, although probably agitating the solution might remedy this, and so perhaps render the deposited alloy of some practical interest. It is rather strange, in view of the results obtained, that many electroplaters' test books warn the silverplater against having traces of copper in his bath, less the deposit acquire a pinky tinge. This will not be the first statement of its kind relegated to the region of myth by exact science. We look forward to Mr. Field's further experiments, particularly those on the copper-tin series, because the deposition of bronze is of considerable interest.

The Electro-analysis of Metals.

This paper describes an experimental study by Dr. F. Mollwo Perkin and Mr. W. E. Hughes, carried out in order to ascertain the most efficient form of apparatus to use for the rapid electro-analysis of metals. Several forms of rotating platinum anodes or cathodes are described, but the form finally recommended consists of an inner rapidly-rotating anode made of a closely-wound spiral of iridio-platinum wire, with an outer cylinder of very fine platinum gauze to serve as cathode. The vessel for holding the electrolyte is a cylindrical funnel, with a glass tap at the bottom to facilitate the removal of the liquid and the thorough washing of the cathode. With this apparatus it was found possible to use very high-current densities, and hence determinations of a considerable degree of accuracy can be made in 10 to 15 minutes.

The accompanying diagram shows how the apparatus can be adapted if it is desired to make potential measurements. The capillary end of the auxiliary electrode cell is inserted down the

side tube of the funnel and bent round, so as to come as near as possible to the back of the cathode. The potentiometer can be used in combination with an ordinary mirror galvanometer, as auxiliary cell the $Hg_2SO_4 . \frac{N}{1} H_2SO_4$ combination being used, with a pressure of 0·956 volt. The connecting solution consisted of 10 N. WH_4WO_3, recommended by Dr. A. C. Cumming as it eliminates liquid potentials.

Mr. F. P. Bent read a paper on "The Compressibilities of Helium and Neon."

Dr. A. C. Cumming described a form of gas-washing bottle that offers very slight resistance to the passage of gas.

The meeting terminated with the exhibition by Prof. E. Kilburn Scott of a gas-pressure sprayer working with calcium carbide. Several thousand of these sprayers are in use in Australia, mostly for spraying fruit-trees. The acetylene is generated at 100 lb. pressure, and the growing use of the sprayers in Australia points to a considerable market there for calcium carbide in the future.

LOCAL AUTHORITIES AND TENDERS.

[BY OUR LEGAL CONTRIBUTOR.]

In the last issue of the Review, page 122, there appeared an article entitled, "Fair Consideration for the British Tenderer," in which it was pointed out that local authorities in England evince an increasing tendency to give preference to British firms. Apart from the commercial and political aspect of the question, it is interesting to consider how far this practice is in accordance with the law.

Take, for instance, an extreme case. Suppose a reasonable figure for certain work was £1,000. Tenders are invited, and a foreign firm offer to do it for £750, while the lowest British tender is £1,500. Would a local authority have power to accept the higher tender, on the ground that it would be a benefit to British trade?

It is clear, in the first place, that a local authority need not necessarily accept the lowest tender. In the recent case of Rex *v.* Robarts (*ex p.* Burley), 1908, 24 T.L.R. 226, a district auditor, acting under Sec. 247 of the Public Health Act, 1875, made certain surcharges against the Highways Committee of a local authority in respect of a contract for the supply of goods, on the ground that the tender accepted was not the lowest, and he disallowed the amount which he estimated as the loss to the ratepayers therefrom. The committee stated that they had accepted the tender which they considered the most advantageous. An application was made for a writ of *certiorari* to bring up and quash the disallowance. It was held that, with regard to the contract for the supply of goods, the Highways Committee had acted honestly in the matter, that there was no evidence of negligence, and that the acceptance of the tender was proper.

Applying the principle of the above case, the only question which the auditor has to consider is—Did the local authority, in accepting this tender, act honestly and without negligence? It could hardly be called dishonest to accept a particular tender because it gave employment in the district or to the community at large; it could scarcely be termed negligent to pay a little more for a particular piece of work, provided it was certain that the work would be properly carried out by competent persons.

Urban authorities are compelled by law to offer certain contracts for public tender. Thus it is provided by Sec. 174 (4) of the Public Health Act, 1875, that before any contract of the value or amount of £100 or upwards is entered into by an urban authority, 10 days' public notice, at the least, shall be given, expressing the nature and purpose thereof, and inviting tenders for the execution of the same, and such authority shall require and take sufficient security for the due performance of the same. Here would have been the opportunity for the Legislature to insert provisions to ensure that the "lowest tender" shall be accepted, but as they did not do so, it is manifest that local authorities were intended to have a discretion.

It is impossible to consider the question under discussion without coming across another problem which frequently arises in relation to contracts by local authorities. Are they entitled to specify that a particular type of engine or machinery shall alone be used? We recall an instance (Electrical Review, March 2nd, 1906) in which a certain municipal council, having resolved to extend its electricity plant, sent out to a number of electrical manufacturers a specification in which a special make of engine (one firm's exclusive speciality), was asked for, the type of generator being left open. The matter was not advertised. A firm of engine-builders not making the type specified by the engineer obtained permission to tender, but, contrary to the specification, they quoted for *their own* type of engine. Their price was lowest, but they were ruled out as having failed to comply with the specification. The question whether the engineer to the local authority was within his rights in specifying a particular type of engine is one of great difficulty. The object of the legislation is manifestly clear; it is to give to the public an assurance that there shall be no favouritism, and that the ratepayers' money shall be expended as economically as possible. Bearing this in mind, it is difficult to see how the public gain by a particular make of engine being called for. It is obvious that a man who is preparing a tender will find it much cheaper to quote for an engine of his own make.

The time is bound to come before long when the whole question of "local contracts" will be reconsidered. It is thought by many that the system of audit which now obtains is not sufficiently strict to prevent a great deal of waste. Finally, whatever may be said in favour of allowing the local authority to adopt a cry of which much has lately been heard on political platforms—namely, British work for British workmen—it is clear that there are two sides to the question. From the point of view of English electrical engineering it is well enough, but when these outside considerations are allowed to be taken into account we commence to stand on a slippery slope. There is no saying where it may not lead to.

CONSULTING WORK IN INDIA.

[FROM AN INDIAN CORRESPONDENT.]

It is a very extraordinary state of affairs that up to the present no disinterested consulting electrical engineer of any prominence has been able to obtain a foothold in India; yet in no country under the sun are the services of a man of integrity so much required. Probably he will come, and when he does he ought to succeed beyond measure when he becomes known. The various local or provincial Governments have their Electrical Inspectors, and the Supreme Government has an Adviser; but beyond framing electricity Acts and seeing to departmental, electrical and kindred work, their scope of usefulness is confined, and, of course, rightly. All, or most of the Government electrical men, are capable engineers, some with ripe experience of Indian practical work; but it is only on rare occasions that they can obtain permission from their superiors, or, indeed, have sufficient time, to devote themselves to private consulting work.

Native States requiring electric installations simply have, up to the present, to rely on the advice of private contracting firms as to their requirements—if the contractors are honest and sound, with a reputation to uphold, things have gone well with the customer; if, on the contrary, the contractors are not men of reputation, and are unscrupulous in their methods, the results are shameful. Unfortunately in some Indian States, though many of them are well-governed, and, to outward appearance, clean and free from corruption—it is still not an unknown thing to hear of orders being secured by bribing, or by promising commission to high officials. Things would probably be different if a good, reliable firm of consulting engineers were established; widely known and thoroughly above suspicion; who could in the usual way first find out prospective customers' requirements, draw up a specification and call for tenders, and thus obtain the best at a reasonable price. The want of a consulting engineer is felt as much by small customers

who require only a few fans and lights, as well as by the State or muncipality or private owner, whose wants are more extensive, and whose expenditure may run into lacs. The want, too, is felt by the contractor who is often invited to submit schemes for large work which entail much time and expense to draw up, and for which he very often does not obtain even a polite acknowledgment, let alone an order.

It would probably be uphill work, and perhaps a tiresome wait for an unknown consultant, without a good *clientèle*, to arrive at success; but success would certainly come. Gradually his services and his usefulness would become known and appreciated, and, as before said, he would be welcomed by both the consumer and the reputable contractor. In Bombay and Calcutta there are to be sure a few consulting engineers, but not in the sense that one considers the mighty magnates of Victoria Street, who are in a position to be entirely impartial, and who have no official connection with any firms of manufacturers either at home or on the Continent.

A NEW FERRO-CONCRETE MAST FOR OVERHEAD LINES.

UNDER the name of "Saxonia-mast" a Leipzig firm has recently introduced the improved pole construction shown in figs. 1 and 2. It is of rectangular section, and is erected so that the longest side lies in the direction of greatest stress. It is iron-armoured in both the lengthwise and the

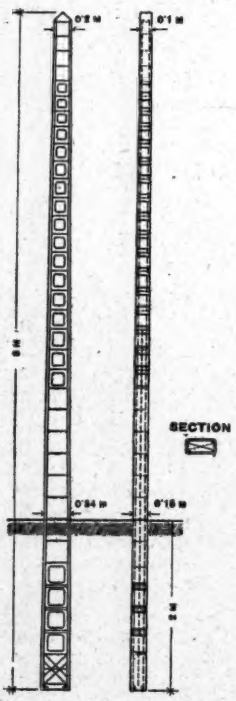


FIG. 1.—DETAILS OF POLE.

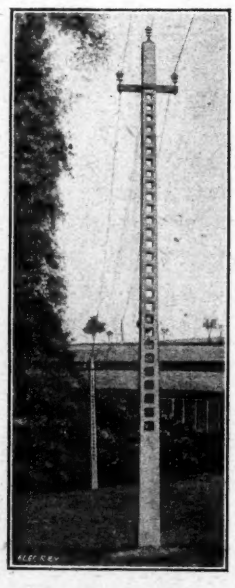


FIG. 2.—POLE LINE.

crosswise directions, and is provided with holes along the neutral zone, partly to save weight and material, partly to reduce the wind pressure and partly to form a natural ladder for climbing the pole. The holes may either be continued all along or may start some two metres from the ground, as shown in the illustrations.

The chief advantages of these masts are (1) the simplicity of manufacture in cheap wooden or iron moulds, if desired in the near neighbourhood of the place of erection; (2) the readiness with which the erection of the line can be carried out without the use of ladders; and (3) the long life of the masts without the need for any paint or other protective coating. Some 1,800 of the masts shown in fig. 2 are in use on the Reichenbach transmission scheme, and many other undertakings have adopted them.—*E.T.Z., January 13th*, 1910.

AN ELECTRIC GAS METER.

A PAPER bearing this title was read before the American Society of Mechanical Engineers by Prof. Carl C. Thomas, of Madison, Wis., in December, 1909.

The operation of the meter depends upon the principle of adding electrically a known quantity of heat to the gas, and determining the rate of flow by the rise in temperature of the gas, between the inlet and outlet of the meter. The meter possesses the following characteristics:—

(*a*) There are no moving parts inside the meter or in contact with the gas.

(*b*) The accuracy of the meter and its sensitiveness are independent of the rate of flow of the gas, and of fluctuations in pressure and temperature.

(*c*) The meter may be used to measure gas at high pressure as well as at low pressure, and is independent of small fluctuations in pressure, such as those in the discharge from an air compressor or in the suction of a gas engine.

(*d*) The meter produces a continuous autographic record showing the rate of flow and its variation.

(*e*) Meters of comparatively very small size have very large capacity.

(*f*) The meter may be opened for inspection, for blowing out accumulated matter with an air blast, or for washing with gasolene, and it can be dismantled to any extent desired, without interfering with the operation of the plant.

The meter consists of the measuring element, and a by-pass through which the flow of gas can be diverted by means of valves. The measuring element consists of an electric heater disposed across the gas passage so as to impart heat uniformly and at a regular rate to the gas passing through the meter. The temperature of the gas at entering and at leaving is measured and autographically recorded by means of two electrical resistance thermometers, one on either side of the heater.

These thermometers consist of wire wound upon vertical tubes so disposed as to come into contact with all the gas passing through the meter, and are substantially constructed. Diagrams are given in the paper, which show that every small fluctuation in the rate of flow is recorded. On one of them the variations are from 17,000 to 75,000 cb. ft. per hour. A temperature difference of about 4° F. gives a satisfactory record.

If heat is supplied uniformly and at a regular rate, then the difference in temperature will depend solely on the rate of flow of the gas: the smaller the flow, the greater the rise, and conversely. The speed at which the recorder paper travels may be altered.

The meter may be operated in either of two ways. In the first the difference of temperature between inlet and outlet is kept constant, and the watts required to maintain this constant difference of temperature vary directly as the rate of flow. The watts may be measured by a recording wattmeter or a watt-hour meter. The difference maintained is about 5° F., and this is kept constant by a device similar to that used in temperature recorders in connection with resistance thermometers. The variation of energy input is effected by a small motor-controlled rheostat on the switchboard.

The second method allows the energy input to remain constant, and records the difference in temperature. Of these two methods the first is superior, as it is independent of any change which might take place in the electrical resistance of the material composing the heater. The second method requires the maintenance of constant voltage, and constant resistance of the heater, or it becomes necessary to record both the energy input and the temperature difference. The meters can be arranged to operate with either continuous or alternating current, and the controlling device can be made to suit any voltage.

A test was made in which the electric gas meter was compared with a newly calibrated wet meter, with satisfactory results.

The specific heat of a given kind of gas appears to be nearly constant, and a table is given showing the specific heat of illuminating gas and its various constituents; there is also a table referring to blast-furnace gas, the specific heat of which is almost identical with that of atmospheric air. The presence of ordinary amounts of water vapour has no effect on the accuracy of the meter, as the water does not undergo a change of state.

The quantity passing can be closely calculated from a knowledge of the energy input and the specific heat of the gas, and this affords an additional check on the meter's accuracy.

Prof. Thomas has for some years been experimenting with reference to the determination of the specific heats of gases by heating them electrically, and the regular performance of a properly constructed heater led him to the idea that it might be used for the purpose indicated in the paper. The whole process of heating and temperature measurement is accomplished in a relatively small space, thermally insulated from the metallic walls of the meter.

The curve connecting the degrees rise in temperature per kilowatt introduced with the rate of flow takes the form of a rectangular hyperbola, asymptotic to the co-ordinate axes. The product, weight of gas multiplied by degrees rise per watt introduced, is a constant, and this constant, for a given kind of gas, takes the place of a calibration curve.

As the meter takes note of the quantity of the gas, and not only of the volume, changes in the pressure do not affect its accuracy. The temperature of the incoming gas does not affect it, as it is the difference in temperature between inlet and outlet upon which the

measurement depends. With gas engines and air compressors these features of the meter render it especially useful.

The temperature difference maintained can be altered to suit different rates of flow of gas. The electrical energy required is approximately 1 kw. per 50,000 cb. ft. hourly capacity.

The meter is arranged to be easily opened for cleaning and inspection, and all its parts are of substantial construction, and made of well-known and reliable materials.

A modified form of the meter can be used for the measurement of steam, and also for determining its quality or the percentage of moisture in it. For quantity measurements the steam is slightly superheated between the boilers and the meter. The measurement of superheated steam is simpler than is the case where superheat is not used. The amount of moisture in steam can be measured by passing all the steam through the meter and noting the amount of energy required to dry it and cause superheating to commence. Tests may be made by passing all the steam—which is, of course, the most accurate method—or only occasional samples, through the measuring element of the meter. The by-pass may be used as in the case where the instrument is used as a gas meter.

The automatic recording device is so arranged that in the event of the flow of gas ceasing, the current is cut off at the switchboard. Further, if the flow becomes too small or too large for the making of a satisfactory record, the rheostat can be altered and the energy input decreased or increased as required. When a constant temperature difference is maintained, the rheostat is motor-controlled, and hand manipulation is unnecessary.

The paper contains nine illustrations, and an appendix gives the data relating to the calibration test mentioned.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"Enquirer" writes:—"Perhaps you could inform me through the legal columns of the Electrical Review whether the corporation can refuse to connect up a 4-h.p. motor where the wiring has been carried out on porcelain insulators. I enclose you a copy of their Regulations.

"The Home Office have written me to say there is no objection to the use of the system for low-pressure circuits, that is, up to 250 volts."

*** The regulations forwarded by "Enquirer" contain the following regulations (*inter alias*) which are taken from those published by the Board of Trade: "All electric lines and apparatus placed on a consumer's premises shall be highly insulated and thoroughly protected against injury to the insulation or access of moisture, and any metal forming part of the electric circuit shall not, unless efficiently connected with earth, be exposed so that it can be touched. All electric lines shall be so fixed and protected as to prevent the possibility of electrical discharge to any adjacent metallic substance." 55. The corporation shall not connect the wires and fittings on a consumer's premises with their mains, unless they are reasonably satisfied that the connection would not cause a leakage from those wires and fittings exceeding one ten-thousandth part of the maximum supply current to the premises; and where the corporation decline to make such connection, they shall serve upon the consumer a notice stating their reasons for so declining. A further regulation provides that if there is a leakage on consumer's premises, the corporation may, by notice, require the consumer to permit an inspector appointed by the corporation to examine the same. It is to be observed that the special regulations as to motors only apply to supply at 440 volts. These are the only regulations which throw any light on the point in question. It is conceived that if the corporation refused to connect up where porcelain insulators are used in the manner suggested, the consumer would be able to assert that they were unreasonably refusing him a supply. Inasmuch as every consumer is entitled to a supply upon similar terms to other consumers in his district, it would seem that the remedy of "Enquirer" would be to summon the corporation for not giving him a supply.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

MONTENEGRO.—Metals, wrought, also tools, instruments, glassware, porcelain ware, &c., and machines; goods not specially mentioned in the Tariff, 10 per cent. *ad valorem*.

MONTSERRAT.—The following are admitted free of duty:—Railway and tramway rolling stock and materials for permanent way; steam engines, steam pipes, boilers, boiler tubes, firebars, machinery, whether stationary or portable for agriculture, irrigation or mining, or machinery for the local industries, not imported for sale. Stores of every description imported by or supplied for the use of the Governor, and all goods or stores imported by the Government for the public uses of the Presidency; telegraph wire, telegraphic, telephonic and electrical apparatus and all appliances of all kinds for communication or illumination thereby.

N.B.—No person may import or establish any apparatus or installation within the Presidency for the purpose of, or in connection with, wireless telegraphy without a licence from the Governor.

MOROCCO.—Foreign goods imported into Morocco are liable to a duty of 12½ per cent. *ad valorem*. The value of goods is calculated as the cash and wholesale value entered at the Custom House free of Customs and warehouse duties.

MUSCAT.—A duty of 5 per cent. *ad valorem* is levied on goods imported into Muscat.

NETHERLANDS.—Invoices and consignment notes should state the gross weight of packages and the net weight of contents, which should be fully described and the country of origin stated. When various descriptions of goods are packed together, the net weight of each class should be stated separately. The following duties are payable:—

India-rubber goods	5 % ad val.
Chinaware	5 % "
Copper work, lacquered or not, painted or gilt, plated or bronze work	5 % "
Glass and glassware of all sorts	5 % "
Instruments: mathematical, physical, surgical, optical and musical	5 % "
Ironwork, founded, forged or laminated	5 % "
Lamps with or without globes	5 % "

The following are free of duty:—Copper (except copper work lacquered, &c., as above), iron (except ironwork founded, forged or laminated), machinery for purposes of manufacture or agriculture, and all steam engines.

Ad valorem duty is calculated on the current price of the goods in Holland. By current price is understood the price of the goods delivered in Holland, less the amount of Customs duty payable.

Copper.—According to the mid-monthly circular from Messrs. H. R. Merton, visible supplies appear to have reached the peak at 109,000 tons, the return for January 15th being 109,082 tons, or an increase of only 62 tons over that for the end of December. The stocks at English and French ports remain practically the same; if any withdrawals have taken place from one port the difference has been made up at another. Supplies from the States are still somewhat low; from Spain, distinctly low on the mid-month, but this follows a larger return for December. Chile is up to the average. No re-shipments to the States are noted.

The *Financial Times*, in an article issued on January 18th, has a pertinent comment on the maintenance of copper prices in spite of the continual increase of visible supplies. This is attributed to extensive purchases by speculators on both sides of the Atlantic, who were interested in upholding prices. The net effect was that, though the average visible supply during the year just about doubled, the average price of standard did not fall more than £1 3s. 1½d., or less than 4 per cent. In England and France stocks increased 55,700 tons, and in the United States 11,500 tons. The price of standard ranged between £54 10s. and £64 2s. 6d., the average being £58 17s. 3d. The production for the whole world in 1909 is estimated at 860,000 tons, or 105,000 tons more than 1908, and 140,000 tons more than 1907. The bulk of this increase has been in the United States, a rise of nearly 16 per cent. over the preceding year being estimated. The production of Canada, Mexico, Peru and Japan has also expanded, as well as that of Australia. Servia is this year credited with 2,000 tons. Chile shows a slight falling off, the quantity exported being 36,100 tons, against 37,200.

The above statistics are quoted from the circular of Messrs. James Lewis & Son. Comparing the United States output, as given by the Copper Producers' Association, with the estimated total world's production, we find that the relationship is as five to seven. The figures given by Messrs. Lewis worked out at nearer four to seven, in the latter case being probably actual production, as against total quantity exported or consumed. In any case, so long as the United States can maintain two-thirds of the world's total output, it must, at the same time, have the controlling influence on the price.

Consumption figures are interesting. The States retained 317,000 tons of their output, as against 221,000 for the previous year. Germany remained fairly constant with 126,800 tons, an increase of only 200 tons. Italy, Austria and Russia took, of American copper—presumably their other supplies are difficult to arrive at—28,800 tons. England took 68,800 tons, against 79,600, this being the lowest figure since 1905. In France a falling off is also noted, the drop being from 64,800 to 58,100 tons.

With reference to the maintenance of prices in the present year, the article referred to points out that this may be effected by limiting output as well as by combination, and that an agreement for this purpose is already concluded, the effect of which is shown on the December figures. The article sums up with an anticipation of restricted output during the ensuing year. It is difficult, however, to be continually turning a mine on and off and to maintain any kind of commercial efficiency, and therefore restricted output sounds always like accumulated stocks in anticipation of trade activity. This would best be taken advantage of by a combination of the large producers, and therefore the indications are still in favour of such a combination being formed.

Our business-like neighbours have already evinced interest in the copper market, according to the *Frankfurter Zeitung*. The Hamburg association of firms interested in the metal trades has resolved to fix copper prices each day after 2 p.m., for prompt and future delivery. Additions are to be made for copper over 99·3 per cent. purity, and further addition for that over 99·8. The prices refer to stocks in Hamburg, but it is open to the seller to supply from stocks in London, Birkenhead, Liverpool or Swansea.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

1,160. "Improvements in electric shade, rings or holders." M. H. Goldstone. January 17th.

1,164. "Improved electrical incandescent lampholder." H. E. Evans. January 17th.

1,166. "Improvements in apparatus for suspending lamps on supports crossing streets." Deutsche Gasglühlicht Akt-Ges. (Auergess). (Date applied for under Sec. 91 of the Act, September 2nd, 1909, being date of application in Germany.) January 17th. (Complete.)

1,167. "Electromagnetic relays and the like." O. D. Lucas. January 17th.

1,182. "Improvements in motor-generators for converting alternating currents to direct currents." A. M. Taylor. January 17th.

1,187. "Improvements in and relating to electric arc lamps." E. C. R. Marks. (Siemens Schuckert-Werke, Germany.) January 17th. (Complete.)

1,189. "Improvements in electric furnaces." J. H. Reid. January 17th. (Complete.)

1,194. "Improvements in or relating to electric cables." Siemens Bros. and Co., Ltd., and W. Dieselhorst. January 17th. (Complete.)

1,206. "Improvements in systems for electrically-operated submarine mines." Elektriska Aktiebolaget A.E.G. (Date applied for under Sec. 91 of the Act, January 18th, 1909, being date of application in Sweden.) January 17th. (Complete.)

1,248. "Electrical transforming device." J. T. Irwin and S. S. A. Watkins. January 17th.

1,276. "Improvements in electric switches applicable for flash lighting." C. H. Jukes-Browne. January 18th.

1,281. "Improvements in telephone switch apparatus." E. C. R. Marks. (Electro-Mechanical Works, United States). January 18th. (Complete.)

1,290. "Improvements in machines for covering wire, thread cores, cords, flexible conductors, electric cables and the like." C. Sattler. (Date applied for under Sec. 91 of the Act, January 19th, 1909, being date of application in Germany.) January 18th. (Complete.)

1,299. "Commutator for electric machines." Siemens Schuckert Werke G.m.b.H. (Date applied for under Sec. 91 of the Act, February 6th, 1909, being date of application in Germany.) January 18th. (Complete.)

1,296. "Improvements in or relating to time switches." R. F. Venner and R. C. Griesbach. January 18th.

1,298. "Improvements in or relating to telephone systems." S. G. S. Dicker. (Automatic Electric Co., United States.) January 18th. (Complete.)

1,299. "Improvements in or relating to telephone systems." T. G. Martin. January 18th. (Complete.)

1,301. "Improvements in or relating to the manufacture of electric conductors." Siemens Bros. & Co., Ltd., and W. Dieselhorst. January 18th. (Complete.)

1,326. "Improvements in electric clocks." T. J. Murday and Reason Manufacturing Co., Ltd. January 18th.

1,404. "Improvements in or relating to devices for cooling the windings of the rotors of dynamo-electric machinery." Siemens Bros. Dynamo Works, Ltd., and M. Kloss. (Siemens SchuckertwerKe G.m.b.H.) (Application for Patent of Addition to No. 1,679/09. January 19th. (Complete.)

1,419. "Improvements in or relating to telephone systems." T. G. Martin. January 19th. (Complete.)

1,420. "Improvements in or relating to telephone systems." A. E. Keith. January 19th. (Complete.)

1,421. "Improvements in or relating to telephone systems." A. E. Keith. January 19th. (Complete.)

1,422. "Improvements in or relating to telephone systems." E. D. Fales. January 19th. (Complete.)

1,432. "Improvements in or relating to telephone systems." S. G. S. Dicker. (Automatic Electric Co., United States.) January 19th. (Complete.)

1,444. "Improvements in and relating to means for illuminating indicators." A. Junghans. January 19th. (Complete.)

1,460. "Improvements in and relating to apparatus for purifying liquids by electricity." H. B. Hartman. January 19th, (Complete.)

1,461. "Improvements in and relating to purification of liquids by electricity." H. B. Hartman. January 19th. (Complete.)

1,464. "Improvements in electric cables." W. E. Hitch. January 20th.

1,465. "Improved shade-carrier and shade as applied to electric lampholders." F. D. Dewse and R. C. Dewse. January 20th.

1,475. "Improvements in wireless telegraphy." A. Burns. January 20th.

1,476. "Improvements in wireless telephony." A. Burns. January 20th.

1,482. "Improvements relating to the control apparatus for vapour electric rectifiers." R. P. Jackson and H. M. Scheibe. (Date applied for under Sec. 91 of the Act, January 21st, 1909, being date of application in United States.) January 20th. (Complete.)

1,483. "Improvements relating to control apparatus for vapour electric devices." H. M. Scheibe. Date applied for under Sec. 91 of the Act, January 21st, 1909, being date of application in United States.) January 20th. (Complete.)

1,484. "Improvements in electric signalling mechanism." G. K. B. Elphinstone. January 20th.

1,515. "Improvements in electrical controlling apparatus." J. P. Naylor. January 20th.

1,518. "Wireless telephone transmitters." A. A. Jahnke and S. C. Tate. January 20th. (Complete.)

1,544. "Improvements in magnetic compasses." F. H. Sumner. (W. St. Aubin, Westminster.) January 20th.

1,555. "Wireless telegraphy receiver." H. W. Kemp. January 21st.

1,556. "Improvements in and relating to electrical terminals." B. J. Crowley. January 21st.

1,558. "Process to regenerate and improve the structure of lead electrodes of secondary batteries." E. H. Naylor. January 21st.

1,586. "Improved cut-out as applied to dynamos and other electrical apparatus." W. H. Ellis and E. Watts. January 21st.

1,597. "Improvements in contacts for electric lampholders and lamps." Siemens Bros & Co., Ltd., and J. S. Huddleston. January 21st.

1,598. "Improvements in telephone receivers." Siemens Bros. & Co., Ltd., and C. R. Riber. January 21st. (Complete.)

1,611. "Improvements in alternating current polyhase commutator dynamo-electric machines." Siemens & Schuckertwerke G.m.b.H. (Date applied for under Sec. 91 of the Act, February 16th, 1909, being date of application in Germany.) January 21st. (Complete.)

1,631. "Improvements in and relating to intercommunication telephone systems." Sterling Telephone & Electric Co., Ltd., and F. G. Bell. January 21st.

1,649. "Improvements in and connected with electric oscillating systems." E. Wilson and W. H. Wilson. January 22nd.

1,671. "Improvements in automatic prepayment mechanism for use in connection with electricity or gas meters and for analogous uses." B. G. Williams. January 22nd.

1,677. "Improvements in the method of determining when a secondary battery has received its full charge." A. N. Hazelhurst & Longstreths, Ltd. January 22nd.

1,707. "Improvements in or relating to telephone transmitters." A. J. Boult. (B. C. Maxwell, U.S.) January 22nd. (Complete.)

1,710. "Improvements in or relating to electro-magnetic carriers for glass bodies." E. J. Sievert. (Date applied for under Sec. 91 of the Act, January 23rd, 1909, being date of application in Germany.) January 22nd. (Complete.)

1,716. "Improvements in or relating to the working or controlling of electrical machinery." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke G.m.b.H., Germany.) (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

Rotary Contact-Breakers particularly applicable for use with Internal Combustion Engines. D. E. Brown and C. A. Vandervell. 20,897. October 3rd. (Post-dated April 3rd, 1909.)

Appliances for the Electric Lighting and Heating of Vehicles. H. Grob 28,120. December 24th. (Date applied for under International Convention January 2nd, 1908.)

Connector for Rubber Hose Pipe, Flexible Tubing, Flexible Electric Wires, and the like. A. J. Cann. 28,481. December 31st.

Electrically-Actuated Pumps. M. P. Roberts and F. Roberts. 12,864. June 9th. (Post-dated January 11th, 1909.)

Processes and Appliances for Producing Metallic Articles and Combined Metallic and Non-Metallic Articles by Electro-Deposition and the Articles so produced. F. I. Gibbs. 20,858. October 3rd.

Apparatus for Electrically Operating or Controlling Railway or Tramway Points, Bars, Frogs, Signals and such like Appliances. C. H. W. Edmonds, and McKenzie & Holland, Ltd. 21,398. October 10th. (Post-dated March 26th, 1909.)

Wireless Facsimile Telegraphs. H. Knudsen. 23,570. November 4th.

Electric Light Signs. H. Palmer. 25,882. December 1st. (Cognate application, 12,304/1909.)

1909.

Governing of Electric Motors. H. C. E. Jacoby. 23,619. October 15th. (Date applied for under Rule 13, December 23rd, 1908.)

Arrangements of Circuits for Magneto-Ignition Purposes. J. L. Milton. 24,652. October 26th. (Date applied for under Rule 13, October 20th, 1908.)

Telephonic Receivers. E. A. Graham. 25,112. November 1st.

Telephone Mouthpieces. C. W. Clough. 26,461. November 15th.

Electric Signalling Apparatus. Siemens & Halske Akt.-Ges. 26,465. November 15th. (Date applied for under International Convention, December 7th, 1908.)

Alternate-Current Meters. G. C. Fricker and W. M. Mordey. 129. January 2nd.

Manufacture of Refractory Electric Conductors. W. D. Coolidge. 282. January 5th. (Date applied for under International Convention, September 23rd, 1908.)

Electric Time Switches. H. F. Reason and Reason Manufacturing Co. 353 January 6th.

Voltage Regulation of Alternators and Alternating-Current Systems. D. K. Morris and G. A. Lister. 416. January 7th.

Electric Motor Controllers. British Thomson-Houston Co. (General Electric Co.) 551. January 8th.

Trolley Arms for Electric Traction Systems. E. M. Munro and Railless Electric Traction Co. 764. January 12th.

Electrical Insulating Material. British Thomson-Houston Co. (General Electric Co.) 2,128. January 28th.

Electrically-Operated Valves. E. A. Fagerlund. 2,740. February 4th. (Date applied for under International Convention, February 5th, 1908.)

Electrical Controllers. J. B. Tannahill. 3,560. February 13th.

Method of and Apparatus for Armouring Cables or the like with Metal Tubing. E. Witzenmann. 4,957. March 1st.

Means for Charging and Discharging Storage Batteries. W. Fennell and W. P. Perry. 6,773. March 22nd.

Electromagnetic Apparatus for Distributing Electric Current, Gas, or other Fluid. L. Pralon, I. Françon and G. Fournier. 10,456. May 3rd. (Date applied for under International Convention, May 2nd, 1908.)

Arrangement for Varying the Connections of Electrical Apparatus. Siemens Bros. & Co., E. F. H. H. Lauckert and J. Nebel. (Partly Siemens and Halske Akt.-Ges.) 10,550. May 4th.

Current Collectors for Electric Traction Systems. E. M. Munro and Railless Electric Traction Co. 11,947. May 20th.

Telephone Exchanges. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 13,749. June 11th.

Magneto-Electric Machines. E. Troike. 14,153. June 16th.

Telephone Systems. P. Stragiotti. 17,473. July 27th. (Date applied for under International Convention, August 11th, 1908.)

Electric Telephone Relays. P. Stragiotti. 17,542. July 28th. (Date applied for under International Convention, August 11th, 1908.)

Electrical Ignition Mechanism for Internal-Combustion Engines. A. Giraud. 20,241. September 3rd. (Date applied for under International Convention, September 3rd, 1908.)

Polyphase Commutator Dynamo-Electric Machines. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges.) 21,542. September 21st.

Thermo-Electric Devices for Indicating the Temperature of Steam on a Steam Locomotive. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 24,389. October 23rd.

Telephone Exchanges. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 25,882. November 9th.

Dynamo-Electric Machines. Allgemeine Electricitäts Ges. 26,146. November 11th. (Date applied for under International Convention, November 12th, 1908.)

Collectors for Electricity for Overhead Conductor Traction Systems. R. Kohler. 26,808. November 20th. (Date applied for under International Convention, May 4th, 1909.)

Controlling Appliances for the Electric Lighting of Vehicles. H. Grob. 27,997. November 30th. (Date applied for under International Convention, January 2nd, 1908.) (Originally included in No. 28,120/1908.)

Automatically-Operated Electric Organs. F. J. Thomas and J. J. Hine. 91. January 2nd.